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DECEMBER 2010

NATIONAL GEOGRAPHIC



THE
SEARCH FOR

King David

New Discoveries
in the Holy Land

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The Bristol Bay watershed is the spectacular home of America's greatest wild salmon fishery and one of the most beautiful and pristine places on earth.

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Tiffany & Co. and other jewelers have publicly announced that we will not use gold from the proposed Pebble Mine. Tiffany's experience in over 173 years of sourcing gemstones and precious metals tells us that there are certain places where mining cannot be done without damaging the landscape, wildlife and communities.

Bristol Bay is one such place.

As we weigh the inevitable risks against the promised reward of the Pebble Mine, we know there will be other gold and copper mines to develop. But we will never find a more majestic and productive place than Bristol Bay.

TIFFANY & CO.

NATIONAL GEOGRAPHIC

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- A Serenade to Swans** 54 The whooper swan is a bird to inspire flights of fancy.
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- Alaska's Choice** 100 In Bristol Bay, the debate is on: gold mine versus salmon runs.
By Edwin Dobb Photographs by Michael Melford
- Bat Crash** 126 A fungus has killed at least one million U.S. bats.
By David Quammen Photographs by Stephen Alvarez

In winter whoopers tend to get along, but fights do erupt—here in Hokkaido, Japan.

STEFANO UNTERTHINER

NATIONAL GEOGRAPHIC

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The world's 24 time zones converge at the South Pole. That's a dilemma for visitors who want to set a clock.

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Serengeti Road

A proposed highway could endanger great herds of wildebeests, zebras, and gazelles as they leave Tanzania each May for Kenya.

WILD

A Nest of Petals

A loner bee found in Turkey and Iran deconstructs flowers to build a shelter for its larvae. Once hardened, the nest is humid inside, strong outside—and absolutely beautiful.

THE BIG IDEA

Gaudi's Masterpiece 24

His brilliantly conceived church in Barcelona has been under construction for 128 years. And it's still far from done.

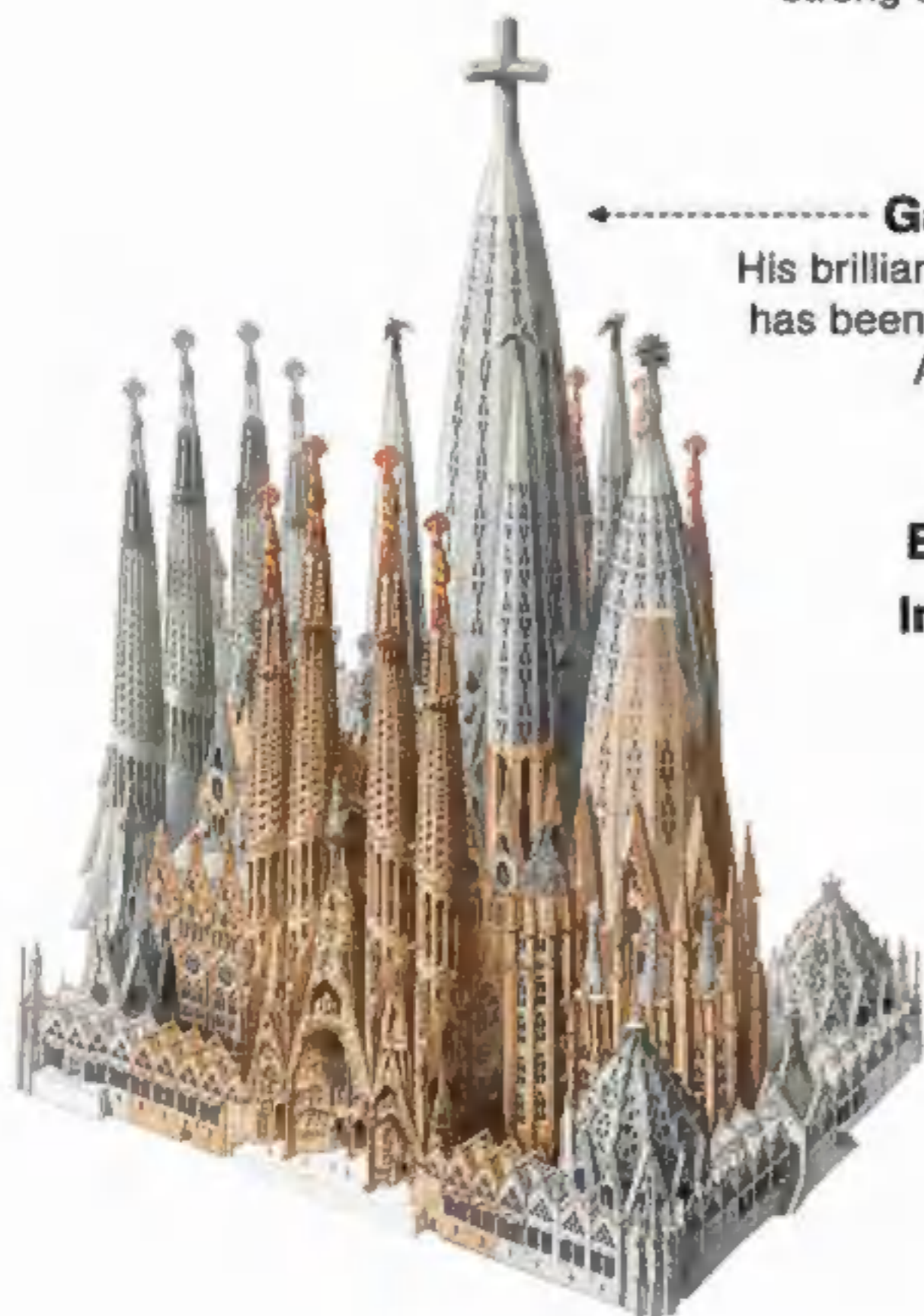
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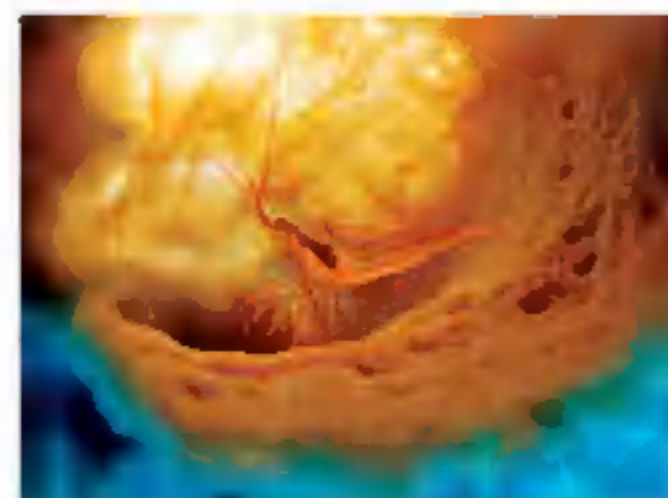
On the Cover

In this painting by Peter Paul Rubens, circa 1616, the biblical king-to-be is poised to wield the sword he took from Goliath.

Art: Norton Simon Foundation



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Your Pic Could Go Here
November 30 is the cutoff for Photo Contest 2010. Topics: Nature, People, Places. Top prize: \$10,000. Above: In last year's nature winner, a peppermint shrimp stands in a sponge.

WILLIAM GOODWIN

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EXCEPTIONAL EXPERIENCES



A National Geographic Photographer Shares Her Passion for Travel.

Catherine Karnow's passion for travel and photography have led her to cover Australian Aborigines, Bombay film stars, Vietnam victims of Agent Orange, Connecticut high society, Albanian farmers, and Britain's Prince Charles. Her vibrant, arresting images have appeared in *National Geographic*, *Smithsonian*, international publications, and numerous books.

"AS A PHOTOGRAPHER, I travel all over the world. But the thing that excites me most isn't going to an exotic place; it's getting to experience a place. When I slow down and stay at one street corner, café table, or scenic overlook it gives me a chance to open up all my senses. Not only feasting my eyes on details, but also tasting, listening, and feeling everything around me.

"As a traveler, with or without a camera, I find people to be welcoming. If you stop to talk and they sense your interest and enthusiasm, you may find yourself invited up to their farm, in for a drink, or over for Sunday lunch. Connecting with people and hearing their stories lets you experience a place as a traveler, not a tourist.



▲ Traveling in Provence, I knew I wanted to photograph a cheese maker. But imagine my delight when I found he lived in such an unusual, photogenic, and intriguing home built right into the rock. Lunch was tomatoes and basil we picked from the garden—served with his delicious homemade goat cheese of course!



▲ This train was slow and sweltering in the July heat of Vietnam. Then, as we came downhill and picked up speed, we finally felt a cool breeze. It was such a relief we all started laughing together. We shared no common language but made a complete connection in the joy of that moment.

"The reason I do what I do isn't to become famous, it's to have these experiences. It can be deeply emotional and profound, or just a special moment with someone who enhances the way you understand and remember your journey. And that can happen whether you're visiting a faraway land or the next town over."

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nationalgeographic.com/ChaseSapphire

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Setnet fishermen on Bristol Bay trap salmon when the fish swim close to shore with the incoming tide.

From my vantage point in the single-engine plane above Bristol Bay, I see an epidemic of salmon fever as big as the state of Alaska. Hundreds of boats are in high gear, chasing the millions of ready-to-spawn sockeye returning to the bay, hauling in nets filled with fish. Many boats are so laden with salmon they ride precariously low in the water, dangerously close to swamping. I had heard about this fishery for years, but nothing prepared me for the enormity of it until I saw it for myself. I was also not prepared for its beauty and remoteness—no dams, development, or human footprint, just endless miles of pristine creeks, lakes, and rivers. This was the wild Alaska I had imagined. A tranquil landscape. Nature at its grandest.

Today, nearly 28 years later, photographer Michael Melford and writer Edwin Dobb see the same breathtaking landscape and find the salmon still running. But the Bristol Bay watershed is no longer tranquil. Instead, it's filled with tension provoked by the discovery of what may be the world's largest deposit of gold and one of the largest deposits of copper. The lode, worth hundreds of billions of dollars, has spawned ambitions for an immense mining complex with an open pit possibly two miles wide and a cavernous underground mine. It's a face-off between salmon and gold; the battle between those who support the mine and those who oppose it has reached a critical point. The risk, the values and priorities, the balancing of potential gains and losses all present uneasy and complicated questions. In this month's issue Melford and Dobb wade into the fight.



Australian Sea Lion (*Neophoca cinerea*)

Size: Head and body length, females 1.3 - 1.8 m (51.2 - 70.9 inches); males 2 - 2.5 m (78.7 - 98.4 inches)

Weight: Females 61 - 105 kg (134.5 - 231.5 lbs); males up to 300 kg (661.4 lbs) **Habitat:** Breeds on about 70 offshore islands in Western and South Australia, and at several mainland sites on the coast of the Great Australian Bight **Surviving number:** Estimated at 14,730



Photographed by Gerry Ellis

WILDLIFE AS CANON SEES IT

Nature's nonconformists. There's something about the Australian sea lion that makes it act differently than its cousins around the world. Alone among pinnipeds, it does not synchronize its breeding season; rather, females at different sites give birth at different times throughout the year. Mothers are fiercely dedicated to their young, staying with them continuously for about the first 10 days and tending them for up to three years.

Males have nothing to do with raising offspring, but defend their territories with gusto. This singular species is among the rarest of its kind, and fatal fishing accidents are making it rarer still.

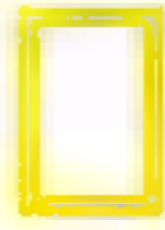
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I CHOSE

✓ To address my fears.

✓ To accept that pills alone weren't enough to control my blood sugar.

✓ To ask my doctor about insulin in a pen.



If you have type 2 diabetes, and diet, exercise, and pills alone aren't controlling your high blood sugar anymore, this could be the time to consider adding insulin to your treatment plan. Insulin is an effective way to lower blood sugar. And today there's an easy-to-use pen to inject it. Make the choice to talk to your doctor about whether insulin is right for you.



Important Safety Information for Lantus® (insulin glargine [rDNA origin] injection)

Do not take Lantus® if you are allergic to insulin or any of the inactive ingredients in Lantus®.

You must test your blood sugar levels while using insulin, such as Lantus®. Do not make any changes to your dose or type of insulin without talking to your healthcare provider. Any change of insulin should be made cautiously and only under medical supervision.

Do NOT dilute or mix Lantus® with any other insulin or solution. It will not work as intended and you may lose blood sugar control, which could be serious. Lantus® must only be used if the solution is clear and colorless with no particles visible. **Do not share needles, insulin pens or syringes with others.**

The most common side effect of insulin, including Lantus®, is low blood sugar (hypoglycemia), which may be serious. Some people may experience symptoms such as shaking, sweating, fast heartbeat, and blurred vision. Severe hypoglycemia may be serious and life threatening. It may cause harm to your heart or brain. Other possible side effects may include injection site reactions, including changes in fat tissue at the injection site, and allergic reactions, including itching and rash. In rare cases, some allergic reactions may be life threatening.

Tell your doctor about other medicines and supplements you are taking because they can change the way insulin works. Before starting Lantus®, tell your doctor about all your medical conditions including if you have liver or kidney problems, are pregnant or planning to become pregnant, or are breast-feeding or planning to breast-feed.

Indications and Usage

Prescription Lantus® is a long-acting insulin used to treat adults with type 2 diabetes and adults and children (6 years and older) with type 1 diabetes for the control of high blood sugar. It should be taken once a day at the same time each day to lower blood glucose.

Do not use Lantus® to treat diabetic ketoacidosis.

Lantus® SoloSTAR® is a disposable prefilled insulin pen.

Please see additional important information on the next page.

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**You are encouraged to report negative side effects of prescription drugs to the FDA.
Visit www.fda.gov/medwatch, or call 1-800-FDA-1088.**

From the maker of Lantus® SoloSTAR®
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BRIEF SUMMARY OF PRESCRIBING INFORMATION

HIGHLIGHTS OF PRESCRIBING INFORMATION

These highlights do not include all the information needed to use LANTUS safely and effectively. See full prescribing information for LANTUS.

LANTUS® (insulin glargine [rDNA origin] injection) solution for subcutaneous injection
Initial U.S. Approval: 2000

INDICATIONS AND USAGE

LANTUS is a long-acting human insulin analog indicated to improve glycemic control in adults and children with type 1 diabetes mellitus and in adults with type 2 diabetes mellitus. (1)

Important Limitations of Use:

- Not recommended for treating diabetic ketoacidosis. Use intravenous, short-acting insulin instead.

DOSAGE AND ADMINISTRATION

- The starting dose should be individualized based on the type of diabetes and whether the patient is insulin-naïve (2.1, 2.2, 2.3)
- Administer subcutaneously once daily at any time of day, but at the same time every day. (2.1)
- Rotate injection sites within an injection area (abdomen, thigh, or deltoid) to reduce the risk of lipodystrophy. (2.1)
- Converting from other insulin therapies may require adjustment of timing and dose of LANTUS. Closely monitor glucoses especially upon converting to LANTUS and during the initial weeks thereafter. (2.3)

DOSAGE FORMS AND STRENGTHS

Solution for injection 100 units/mL (U-100) in

- 10 mL vials
- 3 mL cartridge system for use in OptiClik (Insulin Delivery Device)
- 3 mL SoloStar disposable insulin device (3)

CONTRAINDICATIONS

Do not use in patients with hypersensitivity to LANTUS or one of its excipients (4)

WARNINGS AND PRECAUTIONS

- Dose adjustment and monitoring: Monitor blood glucose in all patients treated with

insulin. Insulin regimens should be modified cautiously and only under medical supervision (5.1)

- Administration: Do not dilute or mix with any other insulin or solution. Do not administer subcutaneously via an insulin pump or intravenously because severe hypoglycemia can occur (5.2)
- Do not share reusable or disposable insulin devices or needles between patients (5.2)
- Hypoglycemia: Most common adverse reaction of insulin therapy and may be life-threatening (5.3, 6.1)
- Allergic reactions: Severe, life-threatening, generalized allergy, including anaphylaxis, can occur (5.4, 6.1)
- Renal or hepatic impairment: May require a reduction in the LANTUS dose (5.5, 5.6)

ADVERSE REACTIONS

Adverse reactions commonly associated with Lantus are:

- Hypoglycemia, allergic reactions, injection site reaction, lipodystrophy, pruritus, and rash. (6.1)

To report SUSPECTED ADVERSE REACTIONS, contact sanofi-aventis at 1-800-633-1610 or FDA at 1-800-FDA-1088 or www.fda.gov/medwatch.

DRUG INTERACTIONS

- Certain drugs may affect glucose metabolism, requiring insulin dose adjustment and close monitoring of blood glucose. (7)
- The signs of hypoglycemia may be reduced or absent in patients taking anti-adrenergic drugs (e.g., beta-blockers, clonidine, guanethidine, and reserpine). (7)

USE IN SPECIFIC POPULATIONS

- Pregnancy category C: Use during pregnancy only if the potential benefit justifies the potential risk to the fetus (8.1)
- Pediatric: Has not been studied in children with type 2 diabetes. Has not been studied in children with type 1 diabetes <6 years of age (8.4)

See Full Prescribing Information for PATIENT COUNSELING INFORMATION and FDA-approved patient labeling

Revised: 04/2010

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African Gem Cutter Makes \$2,689,000 Mistake...Will You?

This story breaks my heart every time. Allegedly, just two years after the discovery of tanzanite in 1967, a Maasai tribesman knocked on the door of a gem cutter's office in Nairobi. The Maasai had brought along an enormous chunk of tanzanite and he was looking to sell. His asking price? Fifty dollars. But the gem cutter was suspicious and assumed that a stone so large could only be glass. The cutter told the tribesman, no thanks, and sent him on his way. Huge mistake. It turns out that the gem was genuine and would have easily dwarfed the world's largest cut tanzanite at the time. Based on common pricing, that "chunk" could have been worth close to \$3,000,000!

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In the decades since its discovery, tanzanite has become one of the world's most coveted gemstones. Found in only one remote place on Earth (in Tanzania's Merelani Hills, in the shadow of Mount Kilimanjaro), the precious purple stone is 1,000 times rarer than diamonds. Luxury retailers have been quick to sound the alarm, warning that supplies of tanzanite will not last forever. And in this case, they're right. Once the last purple gem is pulled from the Earth, that's it. No more tanzanite. Most believe that we only have a few years supply left, which is why it's so amazing for us to offer this incredible price break. Some retailers along Fifth Avenue are more than happy to charge you outrageous prices for this rarity. Not Stauer. Staying true to our contrarian nature, we've decided to *lower the price of one of the world's rarest and most popular gemstones.*

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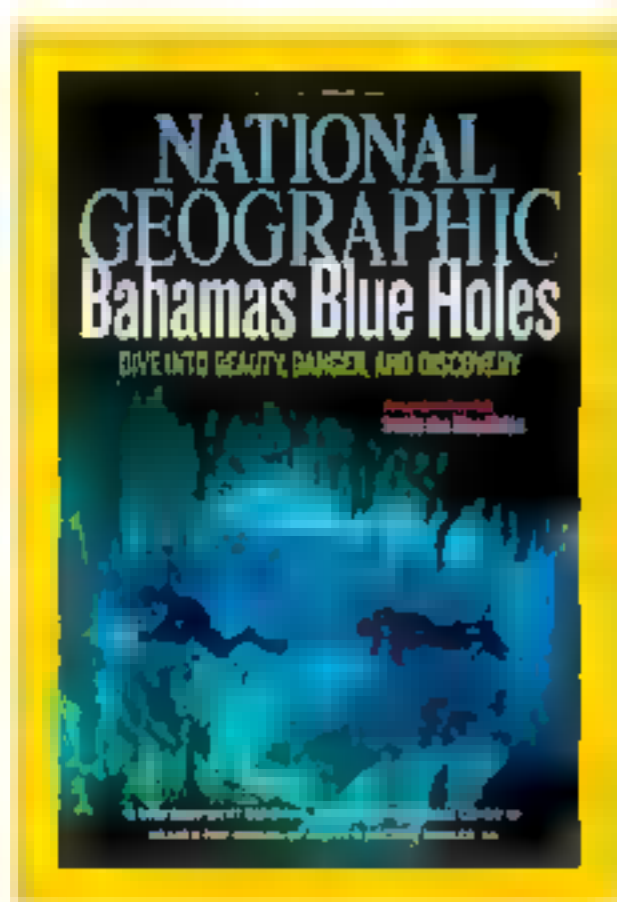


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August 2010

Bahamas Blue Holes

There could be no more fitting tribute to the memory of Wes Skiles than the spectacular cover and gatefold photo in your August issue. I dived with Wes on his first Bahamian blue hole dive more than 25 years ago. I watched him struggling to take photos in an unforgiving environment. We shared the goal of having a photo in *National Geographic*. He succeeded (and brought my dream along with him) when a photograph of his was eventually published. His determination and dedication led Wes to a career that included not only submerged-cave photography but also the conservation of caves and springs in Florida. Wes captured the essence of the beauty and mystery of the blue holes of the Bahamas. I am thankful for this lasting memory and for his sharing the importance of these submerged environments with the world.

JILL YAGER
Puerto Morelos, Mexico

I will never have the opportunity to visit the underwater caves, but the article and photographs by Wes Skiles really made me want to do what is needed to

protect these special places. On a sadder note, I was so sorry to read of Skiles's passing. He was truly an amazing photographer, and as an amateur photographer, I find his work very inspiring. He will forever be remembered through his wonderful photographs.

MATTHEW KARNS
Bloomsburg, Pennsylvania

This article brought back memories of a fun event. My wife and I were cruising with friends on our sailboat. We were approaching Rock Sound, Eleuthera Island, from the west when we noticed an obvious dark spot. We were in about ten feet of water at the time and perhaps ten miles from Rock Sound. As we approached the spot, we realized that it was a blue hole. It was probably a hundred feet in diameter. Visibility was perfect, and we lingered over it for perhaps an hour observing the large ocean fish in its depths. They seemed to disappear and reappear from under ledges. We considered diving into it but were afraid of currents we could not see. Your article does not include this hole in the text or on the map. I would be most grateful if you could provide some information about what we saw.

DAN EDDINS BELLINGER
Severna Park, Maryland

Based on your description, our experts cannot confirm a blue hole in that location, but there are many blue holes that aren't well documented or even named.

Kaziranga: India's Grassland Kingdom

I read this article with immense pride. I am from Assam, and whenever I go there to visit with

my relatives, I stop overnight at Kohora to view the animals from atop an elephant (as pictured on page 108). I have not yet been lucky enough to see a tiger in Kaziranga. When we drive on National Highway 37, we see poor families building thatched houses illegally all along the borders of the park. Government officials seem to ignore such settlement. I believe the land around Kaziranga should be freed for the survival of the animals and that National Highway 37 should be diverted. Recently, one night while driving on that road, my wife and her brother saw a tiger in front of their car, slowly crossing the highway near Kohora.

ARUN B. BARUA
Chicago, Illinois

Ecotourism is so vital to support the people who live near the national parks in India and other countries; it helps strike a balance between the animals that live in the parks and the humans who live outside the parks. I once asked my guide when I was visiting the Jaldapara Wildlife Sanctuary in West Bengal, India, "Are you mad at the elephants who occasionally cause harm to the villagers?" He replied, "Absolutely not, we owe our existence to these animals."

ASHIS ROY
Aldie, Virginia

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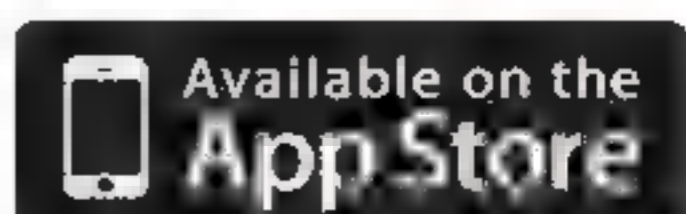
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LETTERS

The New Silk Road

As the executive director of the Karabakh Foundation, an organization focused on Azerbaijan, I found that the discussion of the Baku-Tbilisi-Kars (BTK) railway took me back centuries. The new iron horse is the latest caravan to cross the ancient crossroads of Azerbaijan. Azerbaijan's strategic location has remained a constant. Waves of foreigners, friendly and otherwise, have contributed to a country that is layered in cultural styles. What a historic moment for those of us in an increasingly global environment.

DIANA COHEN ALTMAN
Washington, D.C.

Valley of the Whales

Kudos to author Tom Mueller for the concluding paragraphs of "Valley of the Whales." Like paleontologist Philip Gingerich, my grandfather was a farmer and a Mennonite (non-Amish) lay pastor. I like to think my grandparents wanted to have informed opinions of scientific issues current to their day. A Russian immigrant Mennonite scholar once taught his seminary students that the Hebrew Scriptures' account of creation told us "the who, not the how." Let's not limit faith or science to what our minds can currently understand.

DONNA JOST
Fresno, California

Reviving Native Lands

The article states that tribes are setting examples of ways to restore the environment, yet the lead photo shows a non-native invasive plant, cheatgrass (*Bromus tectorum*), dominating the scene. Granted, cheatgrass is not listed as a noxious weed in New Mexico, where the photo was taken, but it is still considered a problem. It is listed as a noxious weed in neighboring Colorado.

JIM NELLESEN
Rio Rancho, New Mexico



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LETTERS

The Big Idea: Scrubbing the Skies

I maintain that the best way to reduce carbon in the atmosphere is regulation. Consumers should self-regulate, reducing their footprint by consuming less. They should live near their work, refuse to buy products that have excess packaging or ■ short life, and do without unnecessary products. Governments can regulate by pressing companies to create durable goods that are durable and that have low emissions.

AMI PREWETT
Brooklyn Park, Minnesota

Geography: Ready, Set... Map

I have been teaching seventh-grade geography for five years, and every year I require students to draw seven continent or region maps completely from memory. We look at details and draw and draw. Finally they are given a grid with lines of latitude and longitude and a rubric that tells how many landforms, bodies of water, countries, cities, and more are required. The maps that these students produce are amazing. Parents are boggled by how many locations their children recognize during news programs and in magazines.

CHARMAINE JONES
Lutz, Florida

Wild: New Beasts in the East

I found your article on wolf-coyote hybrids interesting; however, I'm concerned about the message of "no need to worry" about wolf-coyote hybrids. While coyote attacks on humans are uncommon, they do occur. Homeowners living where coyotes are observed may avoid harm to family or pets by not feeding coyotes, keeping pets leashed, and supervising small children. Coyotes are large carnivores that are very adaptable. People need to treat them with caution and respect.

PAUL D. CURTIS
Associate Professor and
Extension Wildlife Specialist
Cornell University
Ithaca, New York



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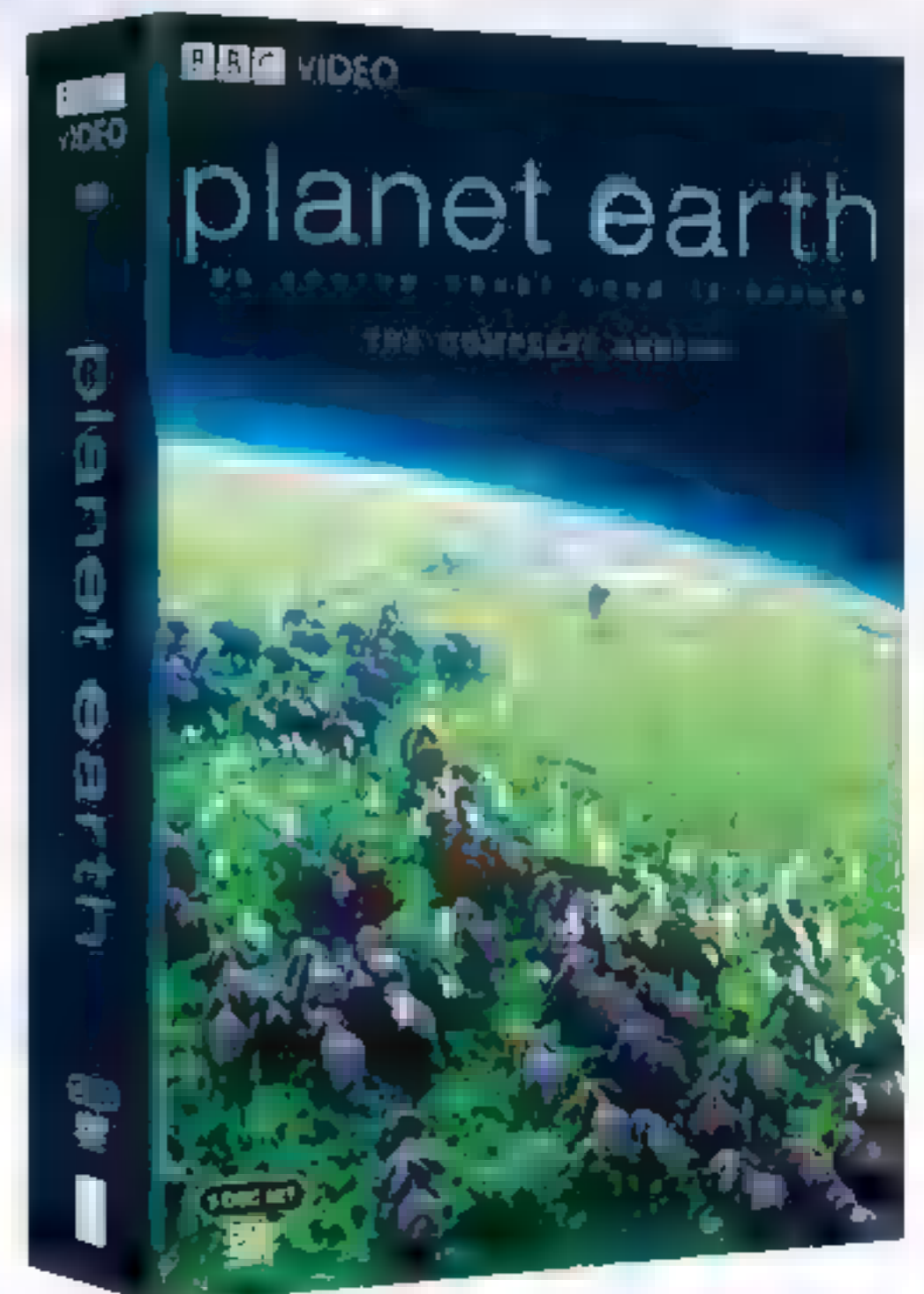
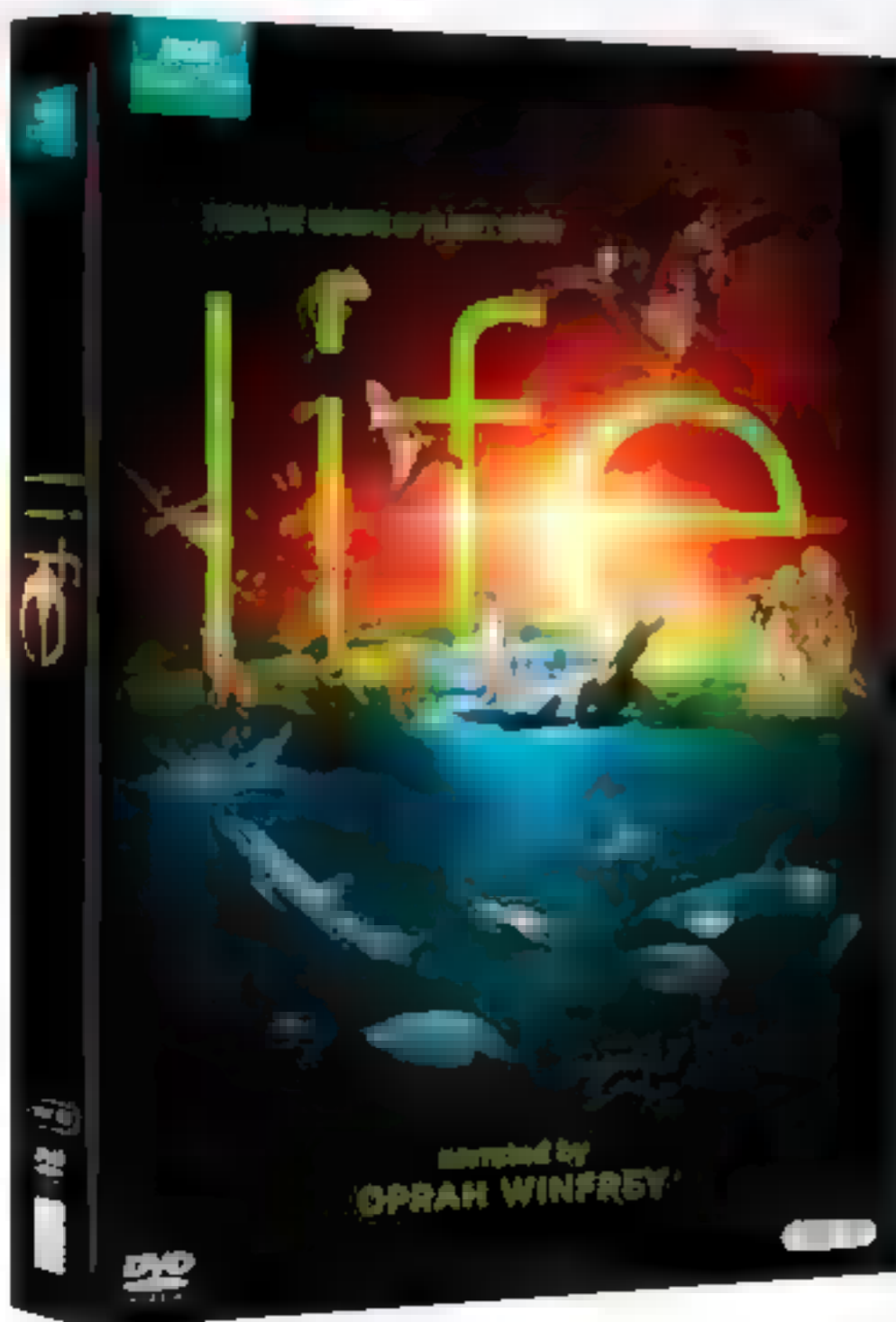
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YOUR SHOT



Kaupo Peetso
Tallinn, Estonia

"Since spring I've seen him almost every time I've walked in front of this house," says freelance photographer Peetso, 34, of this curious hound. "When he is home alone, he is always on the balcony waiting till somebody gets home."

Jim Shedden
Dunchurch, Ontario

Bears are a common sight at Shedden's local dump—and danger. He tried to warn this man of the risk. "I stayed until the truck left, just for safety's sake," he says. Shedden, 53, owns a small cottage resort.



For arthritis patients, it's simple physics:

A body in motion... tends to stay in motion.



Celebrex can help relieve arthritis pain... so you can keep moving.

It's simple physics — a body in motion tends to stay in motion. Staying active can actually relieve arthritis symptoms. But if you have arthritis, staying active can be difficult.

That's why you should talk with your doctor about treatment options, like prescription Celebrex.

- Just one 200mg Celebrex a day can provide 24-hour relief for many with arthritis pain and inflammation.* Relief that can help your body stay in motion.
- In clinical studies with osteoarthritis patients, Celebrex is proven to improve pain, stiffness and daily physical function.
- Celebrex is not a narcotic.

When it comes to relieving arthritis pain, you and your doctor need to balance the benefits with the risks — and find the right treatment for you.

So ask your doctor about Celebrex. It could be an important step towards keeping *your* body in motion.

Visit celebrex.com

or call 1-888-CELEBREX for more information.

You are encouraged to report negative side effects of prescription drugs to the FDA. Visit fda.gov/medwatch or call 1-800-FDA-1088.

*Individual results may vary.



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Important Safety Information:

Like all prescription NSAIDs, CELEBREX may increase the chance of heart attack or stroke that can lead to death. This chance increases if you have heart disease or risk factors for it, such as high blood pressure or when NSAIDs are taken for long periods.

CELEBREX should not be used right before or after certain heart surgeries.

Serious skin reactions, or stomach and intestine problems such as bleeding and ulcers, can occur without warning and may cause death. Patients taking aspirin and the elderly are at increased risk for stomach bleeding and ulcers.

Tell your doctor if you have: a history of ulcers or bleeding in the stomach or intestines; high blood pressure or heart failure; or kidney or liver problems.

CELEBREX should not be taken in late pregnancy.

Do not take CELEBREX if you've had an asthma attack, hives, or other allergic reactions to aspirin, any other NSAID medicine or certain drugs called sulfonamides.

Life threatening allergic reactions can occur with CELEBREX. Get help right away if you've had swelling of the face or throat or trouble breathing.

Prescription CELEBREX should be used exactly as prescribed at the lowest dose possible and for the shortest time needed.

See the Medication Guide on the next page for important information about Celebrex and other prescription NSAIDs.

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Medication Guide

for Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)

(See the end of this Medication Guide for a list of prescription NSAID medicines.)

What is the most important information I should know about medicines called Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)?

NSAID medicines may increase the chance of a heart attack or stroke that can lead to death.

This chance increases:

- with longer use of NSAID medicines
- in people who have heart disease

NSAID medicines should never be used right before or after a heart surgery called a “coronary artery bypass graft (CABG).”

NSAID medicines can cause ulcers and bleeding in the stomach and intestines at any time during treatment. Ulcers and bleeding:

- can happen without warning symptoms
- may cause death

The chance of a person getting ■ ulcer or bleeding increases with:

- taking medicines called “corticosteroids” and “anticoagulants”
- longer use
- smoking
- drinking alcohol
- older age
- having poor health

NSAID medicines should only ■ used:

- exactly as prescribed
- at the lowest dose possible for your treatment
- for the shortest time needed

What are Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)?

NSAID medicines are used to treat pain and redness, swelling, and heat (inflammation) from medical conditions such as:

- different types of arthritis
- menstrual cramps and other types of short-term pain

Who should not take a Non-Steroidal Anti-Inflammatory Drug (NSAID)?

Do not take an NSAID medicine:

- if you had an asthma attack, hives, or other allergic reaction with aspirin or any other NSAID medicine
- for pain right before or after heart bypass surgery

Tell your healthcare provider:

- about all of your medical conditions.
- about all of the medicines you take. NSAIDs and some other medicines can interact with each other and cause serious side effects. **Keep a list of your medicines to show to your healthcare provider and pharmacist.**
- if you are pregnant. **NSAID medicines should not be used by pregnant women late in their pregnancy.**
- if you are breastfeeding. **Talk to your doctor.**

What are the possible side effects ■ Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)?

Serious side effects include:

- heart attack
- stroke
- high blood pressure
- heart failure from body swelling (fluid retention)
- kidney problems including kidney failure
- bleeding and ulcers in the stomach and intestine
- low red blood cells (anemia)
- life-threatening skin reactions
- life-threatening allergic reactions
- liver problems including liver failure
- asthma attacks in people who have asthma

Other side effects include:

- stomach pain
- constipation
- diarrhea
- gas
- heartburn
- nausea
- vomiting
- dizziness

Get emergency help right away if you have any of the following symptoms:

- shortness of breath or trouble breathing
- chest pain
- weakness in one part or side of your body
- slurred speech
- swelling of the face or throat

Stop your NSAID medicine and call your healthcare provider right away if you have any of the following symptoms:

- nausea
- more tired or weaker than usual
- itching
- your skin or eyes look yellow
- stomach pain
- flu-like symptoms
- vomit blood
- there is blood in your bowel movement or it is black and sticky like tar
- skin rash or blisters with fever
- unusual weight gain
- swelling of the arms and legs, hands and feet

These are not all the side effects with NSAID medicines. Talk to your healthcare provider or pharmacist for more information about NSAID medicines.

Call your doctor for medical advice about side effects. You may report side effects to FDA at 1-800-FDA-1088.

Other information about Non-Steroidal Anti-Inflammatory Drugs (NSAIDs)

- Aspirin is an NSAID medicine but it does not increase the chance of a heart attack. Aspirin can cause bleeding in the brain, stomach, and intestines. Aspirin can also cause ulcers in the stomach and intestines.
- Some of these NSAID medicines are sold in lower doses without a prescription (over-the-counter). Talk to your healthcare provider before using over-the-counter NSAIDs for more than 10 days.

NSAID medicines that need a prescription

Generic Name	Tradename
Celecoxib	Celebrex
Diclofenac	Cataflam, Voltaren, Arthrotec (combined with misoprostol)
Diflunisal	Dolobid
Etodolac	Lodine, Lodine XL
Fenoprofen	Nalfon, Nalfon 200
Flurbiprofen	Ansaid
Ibuprofen	Motrin, Tab-Profen, Vicoprofen* (combined with hydrocodone), Combunox (combined with oxycodone)
Indomethacin	Indocin, Indocin SR, Indo-Lemmon, Indomethagan
Ketoprofen	Oruvail
Ketorolac	Toradol
Mefenamic Acid	Ponstel
Meloxicam	Mobic
Nabumetone	Relafen
Naproxen	Naprosyn, Anaprox, Anaprox DS, EC-Naproxyn, Naprelan, Naprapac (copackaged with lansoprazole)
Oxaprozin	Daypro
Piroxicam	Feldene
Sulindac	Clinoril
Tolmetin	Tolectin, Tolectin DS, Tolectin 600

*Vicoprofen contains the same dose of ibuprofen as over-the-counter (OTC) NSAIDs, and is usually used for less than 10 days to treat pain. The OTC NSAID label warns that long term continuous use may increase the risk of heart attack or stroke.

This Medication Guide has been approved by the U.S. Food and Drug Administration.

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EDITORS' CHOICE

Tunc Yavuzdogan Istanbul, Turkey

While on a diving vacation in Indonesia, scuba instructor Yavuzdogan, 40, happened upon this foot-long larval eel in the waters of the Lembeh Strait. "It did move around frantically," he says. "It was very hard to get a decent shot. Its movements were very rhythmic and very fast."

Sharon Zobali New York, New York

Visiting Egypt, says the 23-year-old, "I was on the train traveling to Alexandria when another train passed by right next to me. I quickly took out my camera and captured this man." Zobali studies photography at Parsons the New School for Design in New York City.



READERS' CHOICE

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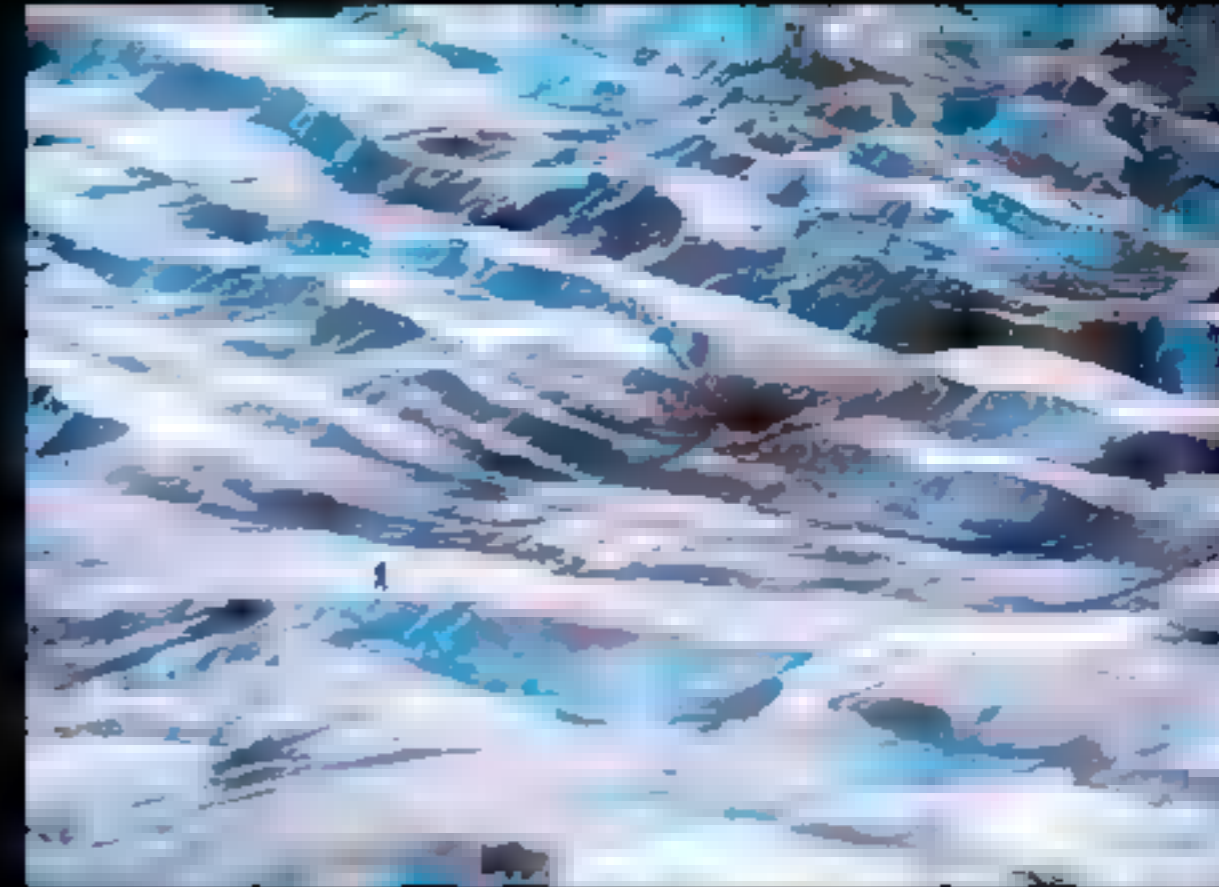


12 FINALISTS WERE CHOSEN

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WILLIAM LEE • Camas, WA



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FRANK FAKINOS • Garden Grove, CA

Internationally
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photographer
Jim Richardson
selected the
grand-prize winner
from this remarkable
group of finalists.



MAGGIE WINTERS • Arlington, VA

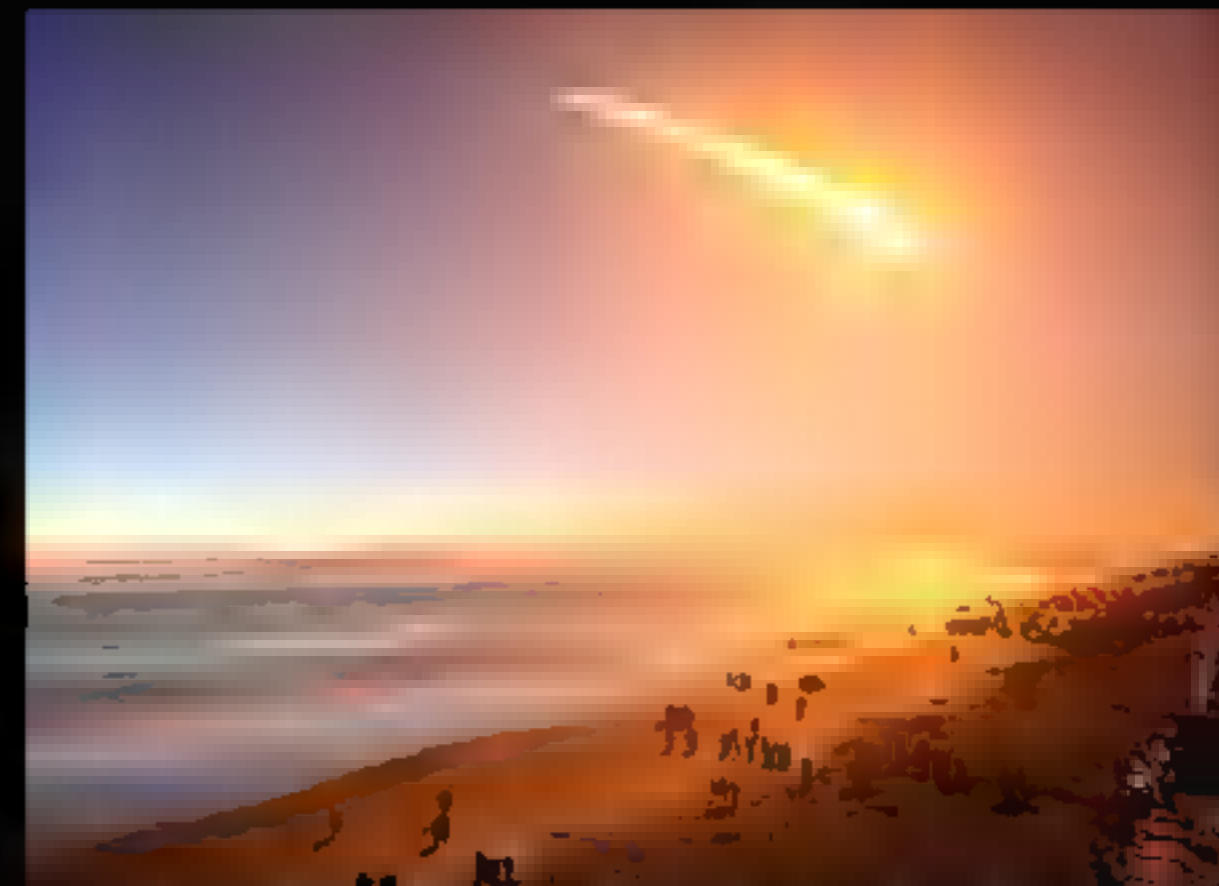


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ROXANNE LOVETT • Statesville, NC



BARRETT HEDGES • Tullahoma, TN

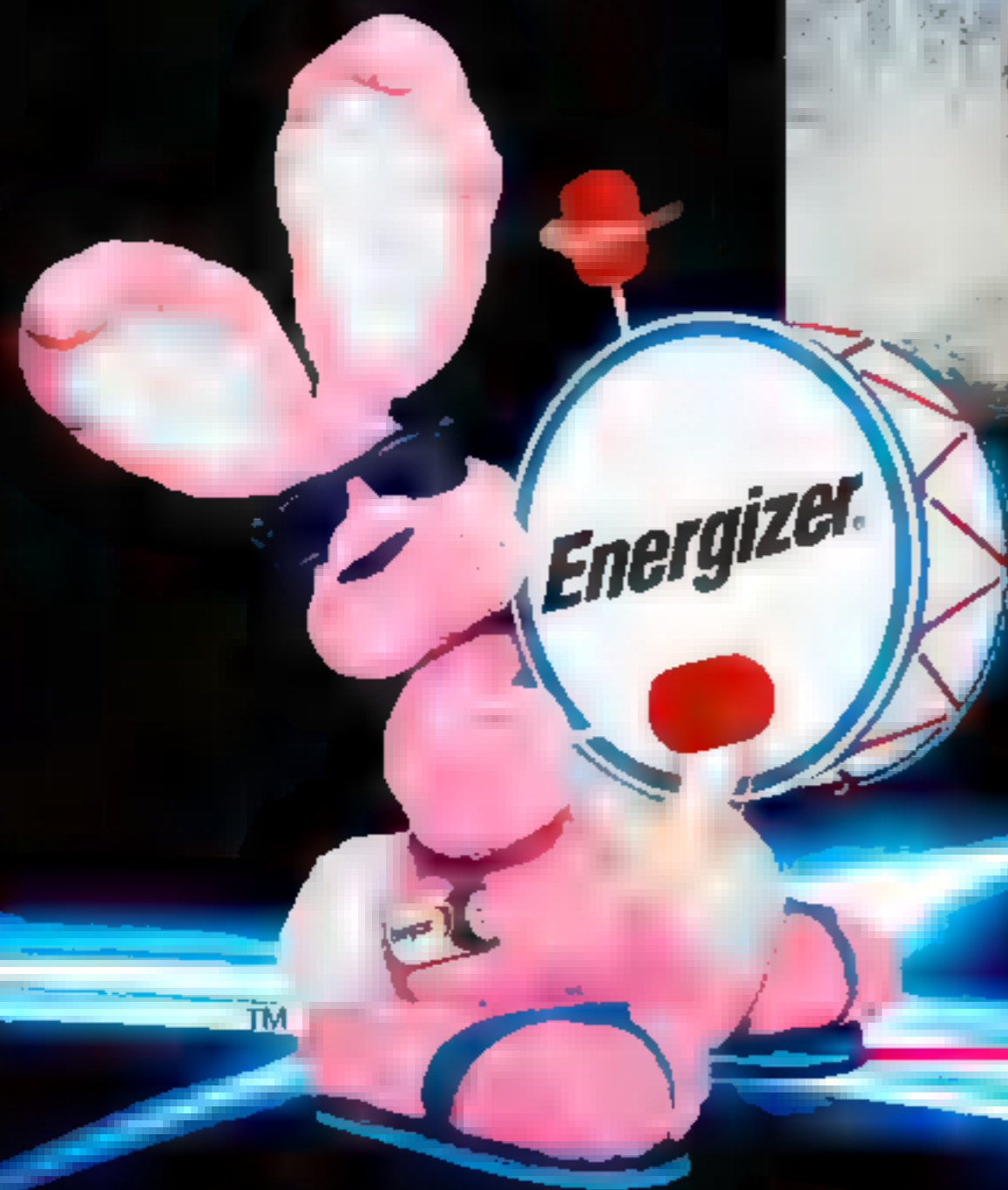


ACTION • ENERGY

MATT WALSH • Gainesville, FL

Energizer

Keep Going®



CONGRATULATIONS to the **2010 ENERGIZER**

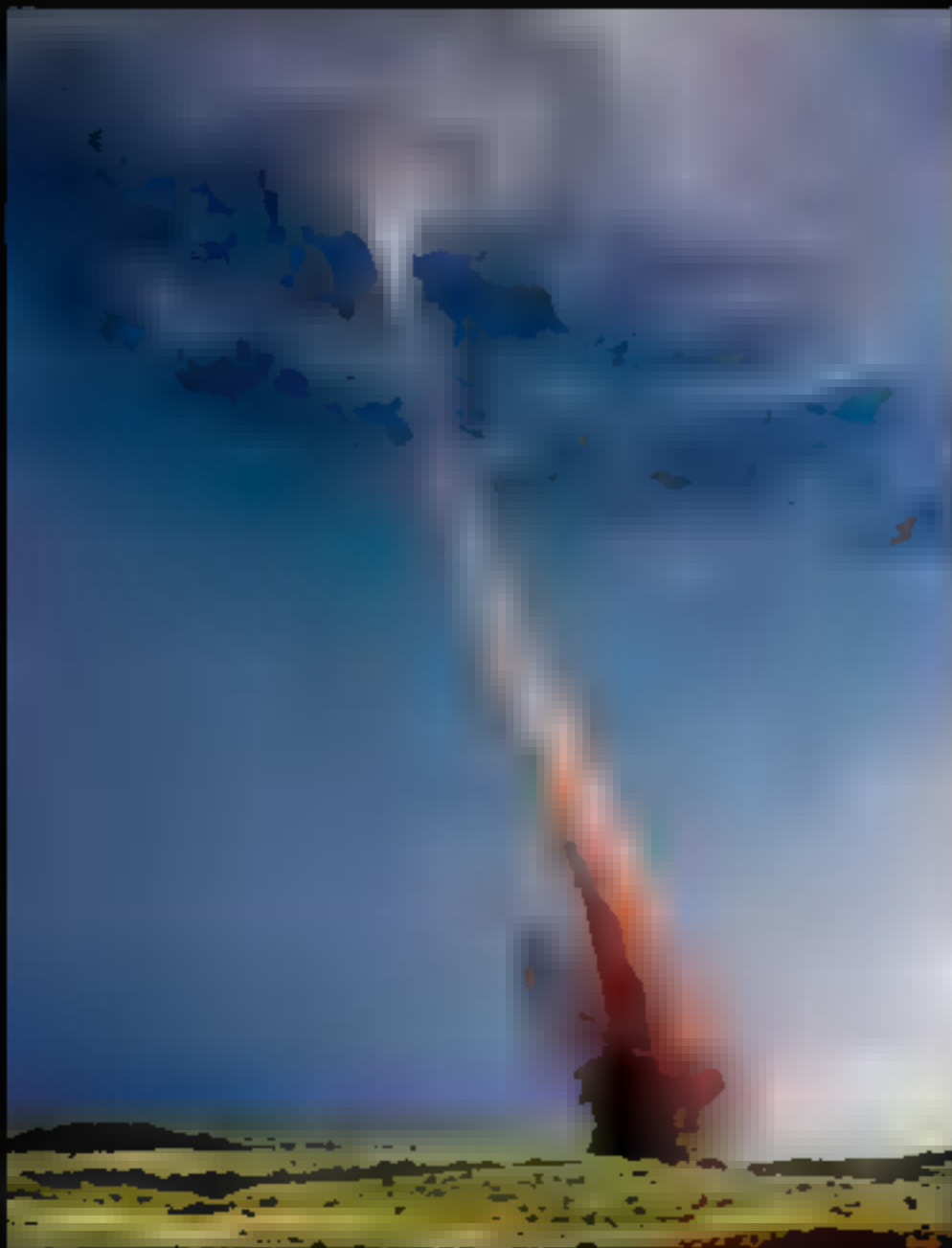


REED MILLER • Rigby, ID

ANIMALS • WILDLIFE



BRIAN OVERCAST • Portland, OR



ZACHARY CARON • Parker, CO

WEATHER

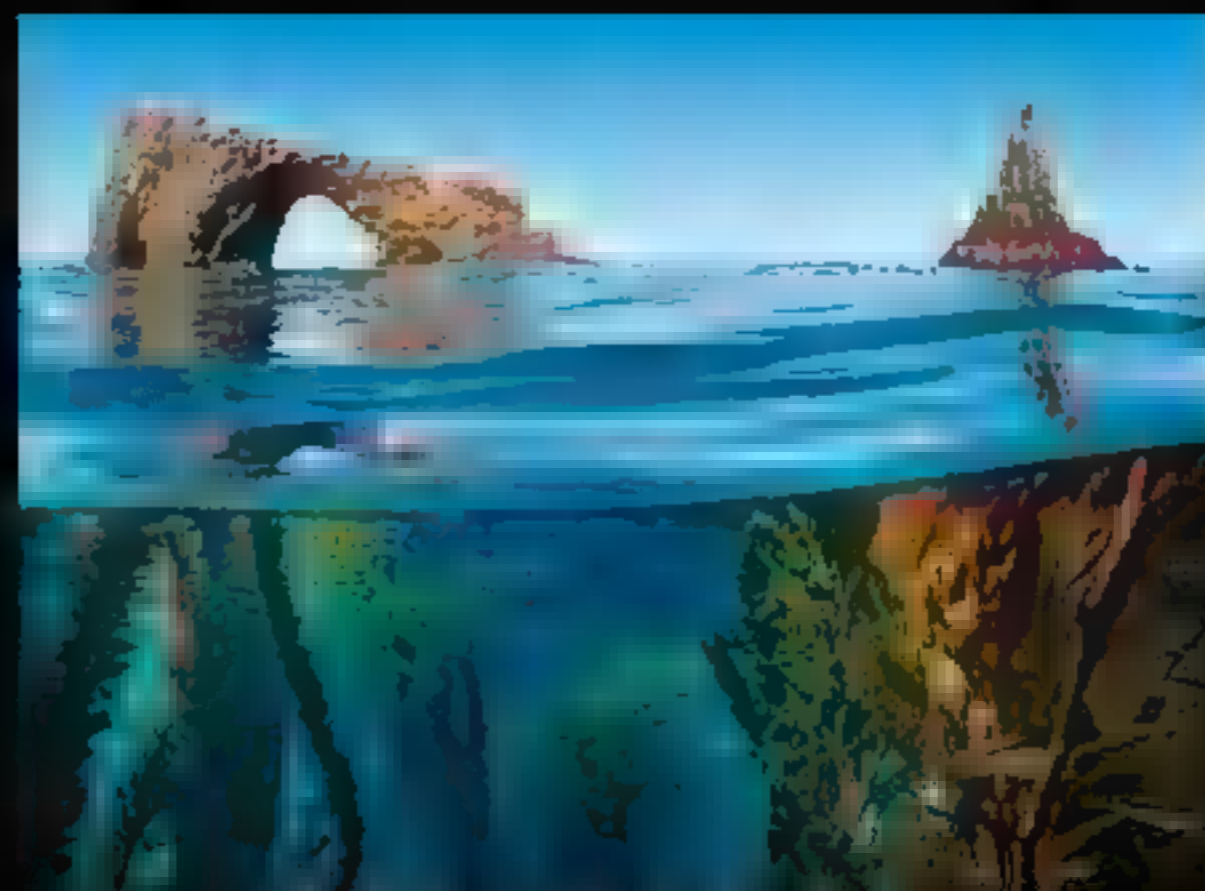


JEFF BERKES • West Chester, PA



BRIAN YOUNG • Cordova, TN

NATURE



ANTONIO BUSIELLO • Camarillo, CA



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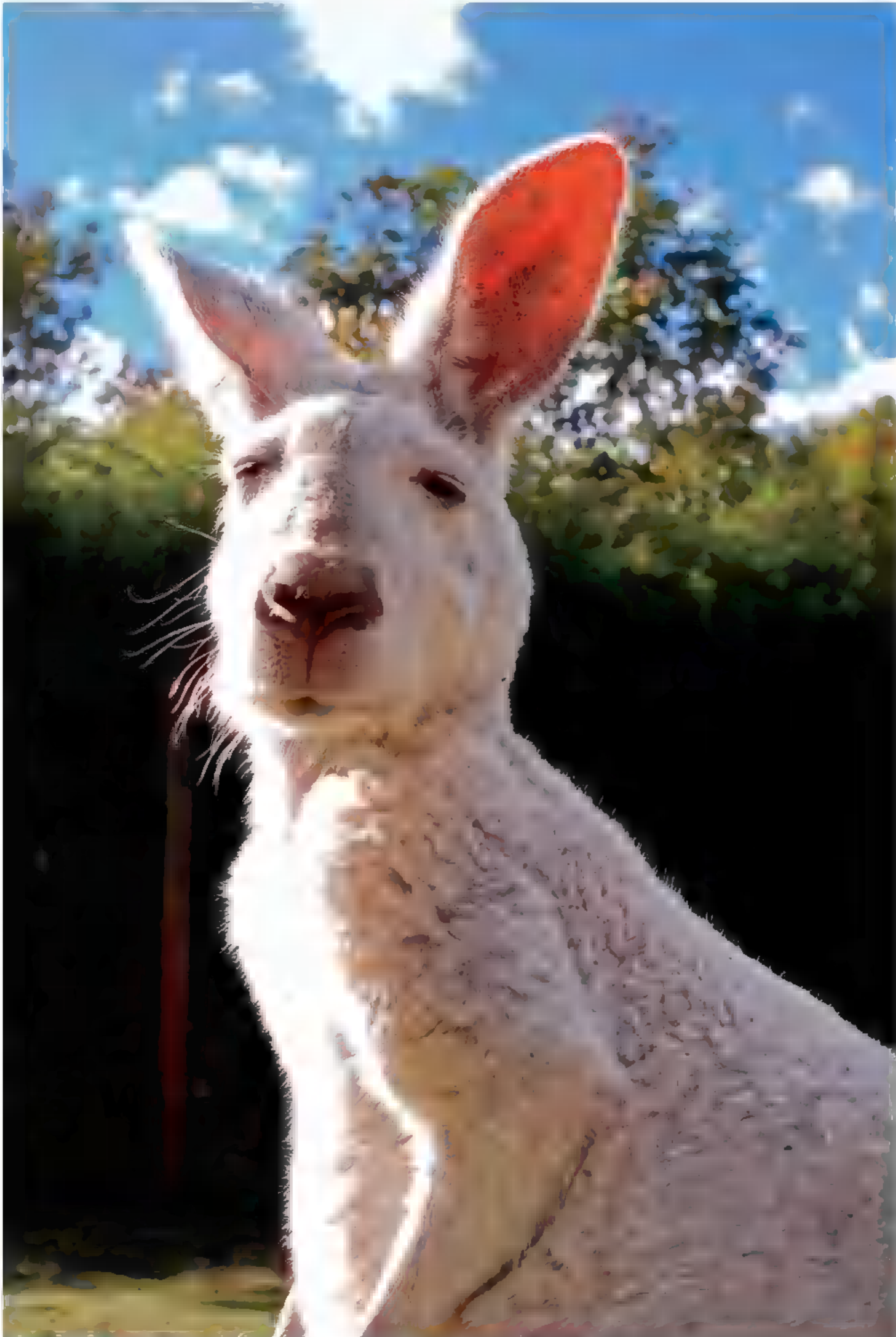


GRAND-PRIZE WINNER **BARRETT HEDGES**, Tullahoma, TN

"What a tough decision! Every one of the twelve finalists is worthy of honor and every one could have been the winner. But after hours of pondering and weighing the decision I kept coming back to that great brown bear, charging straight at us with all the energy of a freight train. Perfectly sharp and face to face with the force of nature, the image carries us into another world, at once frightening and magnificent. The crystalline splashing water frozen in the moment just adds the sense of all-out exertion. Congratulations to our winner, and congratulations to our finalists. It's a bit sad: so many great pictures but only one grand-prize winner."

Jim Richardson, National Geographic photographer and judge in the Energizer Ultimate Photo Contest

YOUR SHOT



Harold Tse Kwai Chung, Hong Kong, China

A white kangaroo regards the photographer at Caversham Wildlife Park in Whiteman, Western Australia. Tse, 20, studies at Hong Kong Polytechnic University.



▲ Antoni Gaudí's La Pedrera.

Shot at 18mm using the Samsung NX10 with 18-55mm lens, f/11, ISO 400, 1/350 exposure.

Capturing Gaudí's Brilliance



LANDON NORDEMAN

Landon Nordeman is a photographer based in New York City. His assignments have taken him from Austria to Australia, Buenos Aires to Budapest, Nebraska to New Zealand. In addition to his work for *National Geographic*, Nordeman has produced award-winning photographs for national and international publications such as the *New Yorker*, *Smithsonian*, *The Atlantic Monthly*, *Sports Illustrated*, and *Saveur*.

Barcelona's beauty stems from the dramatic, sensual people who call this city home. But what inspires their vibrant and effervescent nature? For *National Geographic* photographer Landon Nordeman, Barcelona's secret lies in the buildings that elegantly frame the city, transforming it into a theatrical backdrop for its passionate populace.

In capturing a broad swath of the skyline, dominated by Gaudí's arresting structures, Landon explains, "The challenge was to show it in a unique way while still respecting the design of the architect." To do so, he put the NX10's powerful lens through its paces.

"I used a wide angle to highlight Gaudí's amazing shapes, but also tried to maintain a sense of place and scale in the urban environment." The key to the shot's immediacy, he explains, lies in the successful composition of depth: "Seeing the distant mountains of Barcelona, as well as other city rooftops, gives the image multiple layers."

Thanks to the NX10's ability to perfectly capture subtle tones, it was also able to highlight the enticing color gradation of the sun-warmed stone. Landon says the camera's Smart Range function—which increases dynamic range in a high-contrast scene—was invaluable to this shot, "As it meant I could balance the highlights and shadows of the panorama, without losing any of the image's dramatic detail."



NX10

www.samsung.com
www.samsungimaging.com

SAMSUNG

TURN ON TOMORROW



Photographer Daniel Gordon soars—briefly—over a snowy field in New York's Hudson Valley.

Daniel Gordon's book *Flying Pictures* was published last year by PowerHouse Books. See more of his work at danielgordonstudio.com.

Taking Flight I can fly. I just can't do it for very long. I began taking photographs of myself in flight about ten years ago, when digital cameras were becoming easily available. Because digital images are so simple to alter on a computer, I wanted instead to manipulate photos the old-fashioned way: light through a lens exposing an image on film. This allowed me to make pictures that were at once documents of the truth and a visual fiction.

To fly, I always worked with a friend. I'd find a location, set up my large-format camera on a tripod, and compose the landscape, making a Polaroid of the setting to figure out where I wanted to appear in it. Next I'd walk up to the horizon line of the landscape. My friend would shout to me when I'd reached the place I'd chosen on the Polaroid. Then I'd get a running start and just jump forward, up, and out into the air. My friend would snap the shutter. I'd do this over and over, making one photograph per jump. Of course I'd come crashing to the ground over and over too. In the picture above you can see how red my arms were from landing in the snow so many times. The photographs in this project may show an instant's victory over gravity. But in the end, I always crashed back to Earth.



ARE YOU KIDDING YOURSELF?

A LOT OF PEOPLE THINK EXERCISE AND HEALTHY DIET ARE ENOUGH TO LOWER HIGH CHOLESTEROL. FOR 2 OUT OF 3, IT MAY NOT BE.

Did you know, more than 80% of people who have had heart attacks have high cholesterol? For 2 out of 3 people with high cholesterol, diet and exercise may not be enough. If you haven't been successful in trying to lower your cholesterol on your own, stop kidding yourself. Talk to your doctor about your risk and if Lipitor is right for you. You can also learn more at lipitor.com or call 1-888-LIPITOR.

- When healthy diet and exercise are not enough, adding Lipitor may help.
- Along with diet, Lipitor has been shown to lower bad cholesterol 39-60% (average effect depending on dose) and Lipitor is FDA-approved to reduce the risk of heart attack and stroke in patients who have heart disease or risk factors for heart disease. These risk factors include smoking, age, family history of early heart disease, high blood pressure and low good cholesterol.

IMPORTANT SAFETY INFORMATION:

LIPITOR is not for everyone. It is not for those with liver problems. It is not for women who are nursing, pregnant or may become pregnant.

If you take LIPITOR, tell your doctor if you feel any new muscle pain or weakness. This could be a sign of rare but serious muscle side effects. Tell your doctor about all medications you take. This may help avoid serious drug interactions. Your doctor should do blood tests to check your liver function before and during treatment and may adjust your dose.

Common side effects are diarrhea, upset stomach, muscle and joint pain, and changes in some blood tests.

INDICATION:

LIPITOR is a prescription medicine that is used along with a low-fat diet. It lowers the LDL ("bad" cholesterol) and triglycerides in your blood. It can raise your HDL ("good" cholesterol) as well. LIPITOR can lower the risk for heart attack, stroke, certain types of heart surgery, and chest pain in patients who have heart disease or risk factors for heart disease such as age, smoking, high blood pressure, low HDL, or family history of early heart disease.

LIPITOR can lower the risk for heart attack or stroke in patients with diabetes and risk factors such as diabetic eye or kidney problems, smoking or high blood pressure.

You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.fda.gov/medwatch or call 1-800-FDA-1088.

Please see additional important information on next page.

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atorvastatin calcium
tablets

DON'T KID YOURSELF

lipitor.com

IMPORTANT FACTS



LIPITOR
atorvastatin calcium
tablets

(LIP-ih-tore)

LOWERING YOUR HIGH CHOLESTEROL

High cholesterol is more than just a number, it's a risk factor that should not be ignored. If your doctor said you have high cholesterol, you may be at an increased risk for heart attack and stroke. But the good news is, you can take steps to lower your cholesterol.

With the help of your doctor and a cholesterol-lowering medicine like LIPITOR, along with diet and exercise, you could be on your way to lowering your cholesterol.

Ready to start eating right and exercising more? Talk to your doctor and visit the American Heart Association at www.americanheart.org.

WHO IS LIPITOR FOR?

Who can take LIPITOR:

- People who cannot lower their cholesterol enough with diet and exercise
- Adults and children over 10

Who should NOT take LIPITOR:

- Women who are pregnant, may be pregnant, or may become pregnant. LIPITOR may harm your unborn baby. If you become pregnant, stop LIPITOR and call your doctor right away.
- Women who are breast-feeding. LIPITOR can pass into your breast milk and may harm your baby.
- People with liver problems
- People allergic to anything in LIPITOR

BEFORE YOU START LIPITOR

Tell your doctor:

- About all medications you take, including prescriptions, over-the-counter medications, vitamins, and herbal supplements
- If you have muscle aches or weakness
- If you drink more than 2 alcoholic drinks a day
- If you have diabetes or kidney problems
- If you have a thyroid problem

ABOUT LIPITOR

LIPITOR is a prescription medicine. Along with diet and exercise, it lowers "bad" cholesterol in your blood. It can also raise "good" cholesterol (HDL-C).

LIPITOR can lower the risk of heart attack, stroke, certain types of heart surgery, and chest pain in patients who have heart disease or risk factors for heart disease such as:

- age, smoking, high blood pressure, low HDL-C, family history of early heart disease

LIPITOR can lower the risk of heart attack or stroke in patients with diabetes and risk factors such as diabetic eye or kidney problems, smoking, or high blood pressure.

POSSIBLE SIDE EFFECTS OF LIPITOR

Serious side effects in a small number of people:

- **Muscle problems** that can lead to kidney problems, including kidney failure. Your chance for muscle problems is higher if you take certain other medicines with LIPITOR.
- **Liver problems.** Your doctor may do blood tests to check your liver before you start LIPITOR and while you are taking it.

Call your doctor right away if you have:

- Unexplained muscle weakness or pain, especially if you have a fever or feel very tired
- Allergic reactions including swelling of the face, lips, tongue, and/or throat that may cause difficulty in breathing or swallowing which may require treatment right away
- Nausea, vomiting, or stomach pain
- Brown or dark-colored urine
- Feeling more tired than usual
- Your skin and the whites of your eyes turn yellow
- Allergic skin reactions

Common side effects of LIPITOR are:

- Diarrhea
- Muscle and joint pain
- Upset stomach
- Changes in some blood tests

HOW TO TAKE LIPITOR

Do:

- Take LIPITOR as prescribed by your doctor.
- Try to eat heart-healthy foods while you take LIPITOR.
- Take LIPITOR at any time of day, with or without food.
- If you miss a dose, take it as soon as you remember. But if it has been more than 12 hours since your missed dose, wait. Take the next dose at your regular time.

Don't:

- Do not change or stop your dose before talking to your doctor.
- Do not start new medicines before talking to your doctor.
- Do not give your LIPITOR to other people. It may harm them even if your problems are the same.
- Do not break the tablet.

NEED MORE INFORMATION?

- Ask your doctor or health care provider.
- Talk to your pharmacist.
- Go to www.lipitor.com or call 1-888-LIPITOR.



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New York, NY 10017 USA
June 2009

Rx only

Tourist "Borrows" World Famous Diamond

Not long ago, I walked out of a famous German museum with one of Europe's most precious stones in my pocket. Nobody stopped me at the exit. They never patted me down. Even if they did, they wouldn't have found the 40-carat Dresden Green Diamond. After doing this sort of thing for a while, I've become quite good.

But the truth is that I didn't steal anything. The legendary Dresden Green wasn't missing. I never touched it. But I did bring it with me, sketched onto the back of my museum program. And that design inspired our spectacular *Saxony Green Lab-Created Spinel Necklace*.

Steal the Look of a European Treasure. Gemologists consider the Dresden Green to be the largest and finest natural green diamond ever found. As one of the rarest precious stones in the world, it remains a magnificent example of fancy color, clarity and carat weight. Our *Saxony Green Lab-Created Spinel Necklace* showcases a pale green, lab-created, hand-faceted spinel, created using a complex process that recreates the conditions in which gemstones form in nature. Using intense heat and pressure—carefully controlled inside the laboratory—we've recreated a gorgeous giant worthy of a second look. I even requested a personal favor from our talented gem cutters, asking them to duplicate the facets of the original. I dare say they outdid the Old Masters.

Masterpiece Gets a Modern

Makeover. After centuries of adorning the finery of royals, the green beauty was due for a fashion update. Your *Saxony Green* features a 38-carat centerpiece of pear-cut lab-created spinel that shimmers with vivid green hues. An elegant lariat setting cradles the large stone and sparkles with 110 lab-created DiamondAura® rounds (over 1 full carat), each hand-set in the finest .925 sterling silver. The pendant dangles from an 18" sterling chain.

100% Guaranteed, Better Than FREE and Better Than FREE Shipping! At Stauer, we settle for nothing less than your complete satisfaction. If you are not absolutely delighted with your jewelry, send it back within 30 days for a full refund of the purchase price. But we're so confident that you'll be captivated, we will send \$200 in Stauer Gift Coupons with your \$195 purchase. We call it **Better Than FREE** and you won't find an offer like it anywhere else.

Of course, if I had my way, we'd also ship it to you at no charge. Unfortunately, the rising cost of gas and freight makes that impossible. But what I can do is *send another \$25 Stauer Gift Coupon* to make up the difference. Order your *Saxony Green Collection* today and you can bring home the luxurious look of a legend without breaking the law. And with this deal, you'll still feel like you got away with something.



"This is a stunning necklace... I just keep coming back again and again.. I just love your jewelry. Everything you do you do with such class... thanks again."

— J. from Cleveland, OH

Stauer exclusive
Better Than Free Offer
See details below.

A.



JEWELRY SPECS:

- 38 carat pear-cut lab-created green spinel
- .925 sterling silver settings

Saxony Green Collection

A. Necklace (39 ctw)—~~\$495~~ **\$195 Save \$300!**

B. Earrings (20 ctw)—~~\$295~~ **\$145 Save \$150!**

Complete Set—~~\$790~~ **\$295**

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Set includes earrings and necklace.

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I never wanted the pictures' backgrounds to be too specific or identifiable. Most were either in California, where I grew up, or near Bard College in New York's Hudson Valley. Here I am, barely visible, flying over a Napa Valley field (above).

My flying style (left, aloft in the Hudson Valley) improved over the four years I worked on this project. I had to concentrate on keeping my body parallel to the ground. It's actually very painful to do—even before I hit the ground.

Maternal and neonatal tetanus (MNT) killed 59,000 newborns in 2008 alone.¹ Many women also die due to maternal tetanus every year. MNT has been eliminated in most of the developed world – but it remains a deadly public health threat in 40 developing countries.

The U.S. Fund for UNICEF is partnering with other nonprofit organizations and leading healthcare companies to eliminate MNT. To learn more, visit www.unicefusa.org.



Helping all people
live healthy lives

Partnering to save lives

Preventing the occurrence of maternal and neonatal tetanus (MNT) in developing countries requires uncomplicated solutions and strong partnerships.

BD is partnering with the U.S. Fund for UNICEF to protect newborn children and their mothers from MNT. BD has donated 135 million auto-disable injection devices and more than \$3 million to the initiative.

The total commitment of \$15 million makes BD one of the largest single corporate donors

to the U.S. Fund for UNICEF's MNT campaign and the largest single philanthropic activity in BD's 113-year history.

Named one of the *World's Most Admired Companies* as well as one of the *World's Most Ethical Companies*,² BD provides advanced medical technology to serve the global community's greatest needs.

BD – *Helping all people live healthy lives*

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UP TO:

The Great Energy Challenge?

Do you think you're pretty up to speed when it comes to energy?
Are you doing everything you can to conserve energy and reduce costs?
Check out the **greatenergychallenge.com** for the latest news,
insights from the experts, and challenging, interactive quizzes.
You might be surprised at what you learn.



■ **How much** electricity do "vampires," devices that suck power from the energy grid even when the power is off, consume out of an average household's energy?

■ **Does it** take more energy to recycle an aluminum can or to make a new one?

■ **How much** is the fuel economy of a conventional gas engine reduced when the air conditioner in the vehicle is turned on?

Find the answers to these questions, and much, much more. Go to



<http://greatenergychallenge.com>

The Great Energy Challenge is a three-year National Geographic initiative in partnership with Shell designed to help us better understand the breadth and depth of our current energy situation. The initiative's website is a one stop resource that will encourage us all to make a positive difference in the crucial decade ahead. Here are just some of the things you'll find at greatenergychallenge.com!



Stay on Top of the Latest Energy News

- Edited by National Geographic experts, you'll find some of the most comprehensive news on the web today covering a wide range of topics, from energy to the environment
- Check back often, new updates are posted several times a week
- Use our comments feature to post an opinion about what you're reading



Join in the Conversation With Some of Today's Top Minds in the Field of Energy

- Connect with our newly assembled network of prominent bloggers from all over the energy arena, including a corporate CEO, the dean of a prominent university, a documentary filmmaker, and many more notables
- Share your views and ideas and connect with other citizens around the world

Test Your Energy IQ With Our Interactive Quizzes

Test your knowledge and see how you stack up against others. Here's a sampling of just some of the questions you'll find. Go to greatenergychallenge.com to see how many you got right.

Q: *If you can do one thing only to save energy, which one is the most helpful?*

- Use power strips.
- Unplug TVs you don't use regularly (such as ones in guest rooms).
- Unplug chargers and adapters.
- Limit the time you use clothes dryers.

Q: *What standard homebuilding practice guarantees large heating and cooling losses?*

- Locating heating units in the basement.
- Installing double-paned windows.
- Using fiberglass insulation.
- Hiding ductwork in attics and crawlspaces.

Q: *What global treaty has slashed world greenhouse gas emissions by 11 gigatons a year?*

- The Kyoto Protocol
- The United Nations Framework Convention on Climate Change
- The Montreal Protocol
- The United Nations Convention on the Law of the Sea



A NATIONAL GEOGRAPHIC INITIATIVE IN PARTNERSHIP WITH SHELL





I wonder what people driving by must have thought—seeing this guy in the distance, running and jumping and falling. They never got that perfect flying fraction of a second. This picture (above) was made near Plainfield, Vermont.

Early on I realized that wearing street clothes in these pictures was kind of a distraction, so I started wearing long johns. Sometimes I almost seemed to blend in with the landscape, like this time in Point Reyes, California (left).



MAG = MY PERSONAL GOALS

WE DIDN'T HAVE A LOT OF MONEY GROWING UP. MY PARENTS CAME HERE FROM ECUADOR. THEY RAISED ME TO WORK HARD AND PROVIDE FOR MYSELF. MAKE MY OWN FATE. MY NEW COROLLA IS THE FIRST THING THAT I COULD SAY IS REALLY MINE. NOT USED. NOT A HAND-ME-DOWN. IT MAKES YOU FEEL GOOD. ANOTHER GOAL YOU'VE ACCOMPLISHED. IT JUST MAKES YOU FEEL LIKE YOU'RE DOING STUFF WITH YOUR LIFE. I'M FINALLY ON MY OWN.

*SERGIO MONSERRATE
2010 COROLLA OWNER*



Every Toyota has a story.
And with 35 million Corollas sold worldwide,* we want to hear yours.
Share it at [facebook.com/toyota](https://www.facebook.com/toyota)



Thanks for your story, Sergio!

*Corolla's global sales are based on Toyota Motor Corporation's sales data since Corolla's inception in 1960 through January 2012. ©2012 Toyota Motor Sales, U.S.A., Inc.

VISIONS OF EARTH



Germany Braving fog and snow to visit Bavarian farms in December, a man in St. Nicholas garb leads devilish companions: revelers dressed as Krampus—a mythical Alpine mischiefmaker—toting gift baskets and birch switches.

PHOTO: CARSTEN PETER



Afghanistan At a hospital in Tarin Kowt, a newborn boy is weighed by a midwife. Afghan babies are kept tightly swaddled for a year. Local tradition holds that the practice promotes good posture.





United States Stripes and flakes share space at the Wilds, a refuge in Ohio for rare and endangered species. Here, ■ three-year-old Grévy's zebra named Elvis stomps the winter pen, which adjoins heated indoor quarters.



Order prints of *National Geographic* photos online at [PrintsNGS.com](https://www PrintsNGS.com).

PHOTO: MATT EICH, LUCEO



MY CAMRY TREE

Once I got pregnant with my son we wanted to upgrade to something bigger for a family of four. We bought the 2005 Toyota Camry. We called it "Silver Bullet." Kinda felt like a step up for us. A little bit of luxury - but in our price range. 😊



Los Angeles, 2006

I brought my son home from the hospital in my first Camry. My son is three now and I used to have to drive him to a class that was almost an hour away and she always got me there.

A lot of good memories in that car. Family outings, weekend trips, stuff like that. Silver Bullet was hard to let go of but it was funny - actually, my daughter had the hardest time letting go! She didn't understand that we were getting a new one. She loved the sound system and didn't know how we would listen to all our music!

Every Toyota has a story.

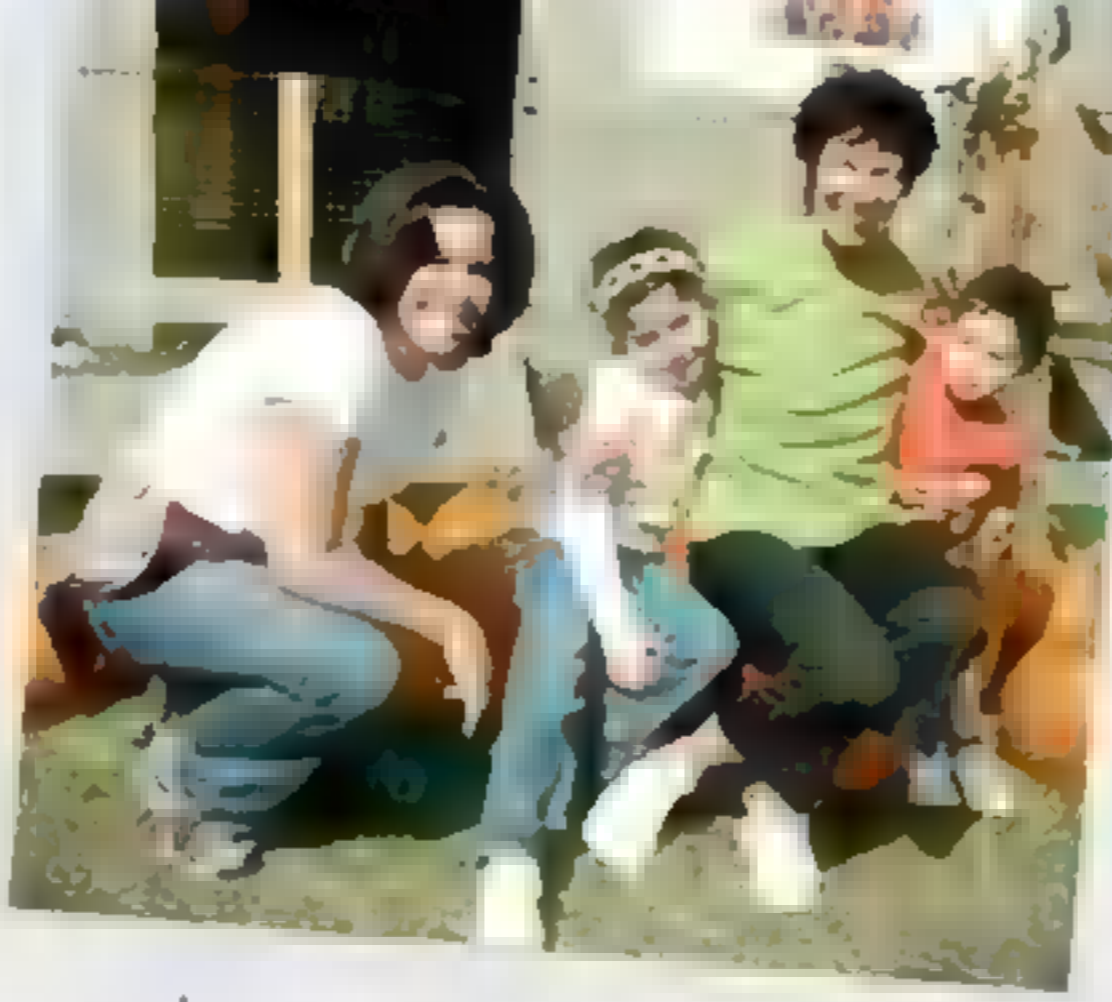
And with 90% of all Toyota Camrys sold in the last 15 years still on the road,* we want to hear yours.

Share your story at [facebook.com/toyota](https://www.facebook.com/toyota)

Thanks for your story, Melanie!



Arizona, 2007



Halloween, 2008



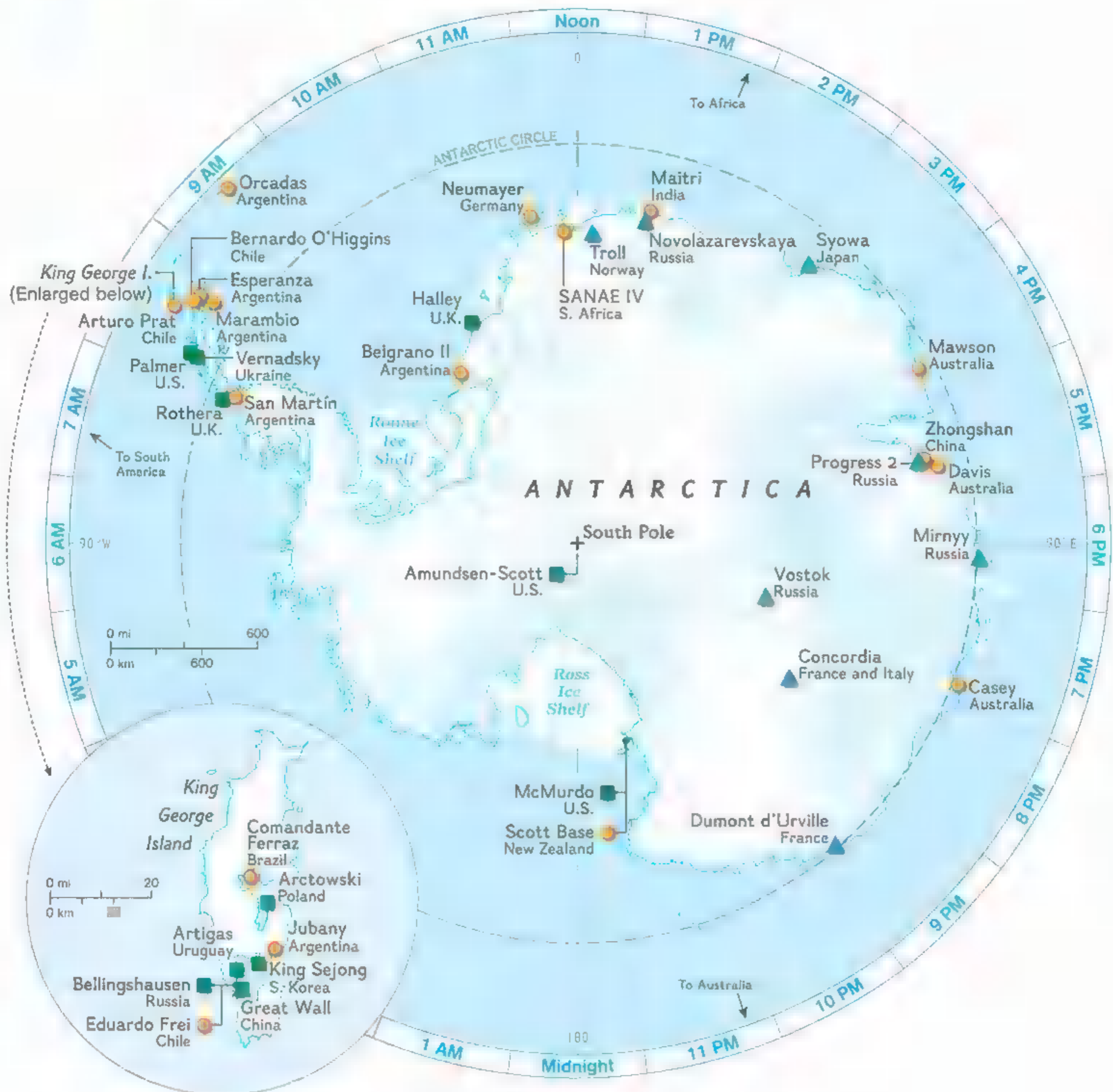
Oh, by the way, my mother loved ours so much she ended up buying a Camry too. Now we both have a 2009. It's a whole family experience.



Melanie
Rosenkranz
2009
Toyota Camry
Owner



GEOGRAPHY



Times used at Antarctic winter stations, 2009

● Home country ■ Departure port ▲ Standard at geographic location

The Timeless Continent

Of the unusual phenomena that occur at the polar extremes of the Earth, time is a particularly peculiar one. Yes, the sky at the South Pole splits the year between whole days of light and dark. But how do humans who venture there—to a place where the world's 24 time zones converge—and to the rest of Antarctica set their clocks?

It all depends. While scientific observations follow coordinated universal time (UTC), each Antarctic research station (above) adopts one

of three practices for coordinating logistics on the ice. The majority keep the time of their home country. Others stay on the clock of the city from which their ships or aircraft departed. Fewer still use the standard time at their geographic location. All of which means a smattering of times on a continent the size of the United States and Mexico combined.

So who plays Father Time at the Pole itself? New Zealand, last port of call for Americans headed to their station at the bottom of the world. —Luna Shyr

CONSERVATION

Animals skitter away from a vehicle in the Serengeti.



A New Road in the Serengeti? Every May when the dry season starts to settle over Tanzania, great herds of wildebeests, zebras, and gazelles head northward, leaving the Serengeti National Park for greener pastures in Kenya. As the rains return in November, so do almost two million animals. Now their migration

path is the focus of a debate over the proposed construction of a commercial highway.

The government says such a road is needed to link the remote Lake Victoria area to ports on the Indian Ocean such as Dar es Salaam (left). It is studying the feasibility of running an unpaved, two-lane stretch across the Serengeti's northern wilderness. But conservationists say hundreds of trucks would use the road daily, risking collisions with migrating animals and increasing the possibility of poaching. They propose a longer route, to the south, that would skirt the park altogether. The country now faces the hard decision of how to balance development with the protection of its iconic wildlife. —A. R. Williams

- Possible commercial road
- Southern alternative
- Other main road





HOUSE BEAUTIFUL

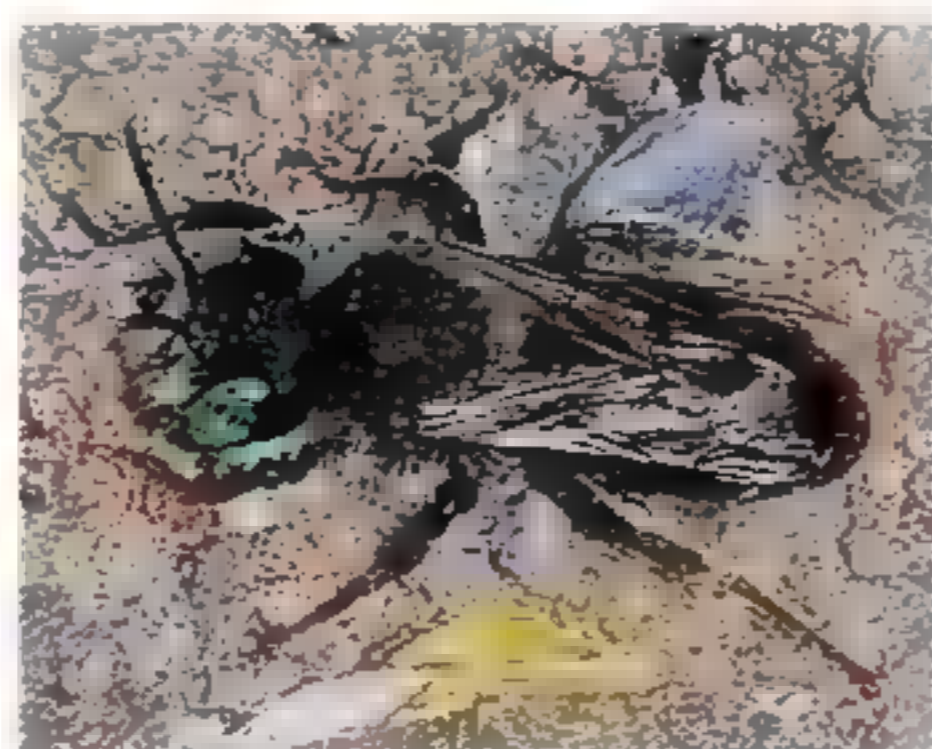
A female bee (below) brings a petal to her unfinished nest. Above are the products of several bees' efforts: brood cells with petal shingles.

Flower Beds Call it ikebana for insects. Female *Osmia avosetta* bees, scientists have recently discovered, arrange flower petals to form unique nests that swathe their larvae in nutrients and warmth for the winter.

Biologists had never seen this species' creations until last year, when two research groups working simultaneously found and excavated nests at mountain-slope sites in Turkey and Iran. Together they report that the female of this solitary bee—which eschews hive life—digs a shallow tunnel in loose ground with room for one or two chambers, or brood cells, each up to two inches deep. She then papers the cell walls with overlapping petals flown in one by one from nearby fields, gluing two layers together with a thin coat of mud. Finally she stocks

each chamber with larval food—a slurry of nectar and pollen—deposits an egg on top, folds the inner petals over, seals the door with damp soil, and ends with another petal fold. The process can take up to two days, the scientists say. The cell soon hardens into a tough nugget that's humid inside and predator- and water-resistant outside—an ideal winter shelter come drought or flood.

A petal nest's loveliness is no doubt lost on the larval bee, which develops in the dark and, without eyes at that stage, can't see regardless. And while scientists appreciate the artistry, says co-discoverer Jerome G. Rozen, Jr., of the American Museum of Natural History, "we're most intrigued by its beauty as an evolutionary mechanism for protecting offspring." —Jennifer S. Holland



"I've always been impressed with Stauer's creativity and this unique watch is no exception."

—George Thomas
Famed Watch Historian

**A Classic
Watch at
a Classic Price!**

Your Ticket to Hollywood's Golden Age

Celebrate the greatest year in moviemaking history with a uniquely retro luxury timepiece.

Hollywood got it right in 1938. Just look at the list of films released or in production that year: *Gone with the Wind*®, *Mr. Smith Goes to Washington*, *The Wizard of Oz*, *The Adventures of Robin Hood*. It doesn't get any bigger or better. Back then, screen idols created the gold standard for movie star style. Just hearing their names conjures an image of sophisticated cool: Cagney, Garbo and Leigh; Gable, Flynn and Tracy. We longed for that bygone era of elegance so much that we decided to build a time machine: the *Stauer 1938 Majestic Watch*.

The Hollywood remake that gets it right. The streamlined Art Deco design and unique display of the *Majestic* was inspired by a rare timepiece style of the 1930s. Wristwatches with digital indication used rotating discs instead of hands to show the time. Finding similar vintage movements in working order is near impossible. And even then, it can cost you a small fortune. But by painstakingly reproducing the complex design, we've given you a more accurate update of the stylish original... **for under \$100.** That's like getting balcony seats at a world premiere for the price of a matinee!

Coming soon to a wrist near you. Like all great film classics, the *Majestic* deserves to be seen. While such a rare design definitely appeals to fine watch collectors, this is a watch that was made to be worn. Inside, a reliable precision movement keeps the time and outside an easy-to-read dial displays the hour and minute through a triangular window in the gold-toned, stainless steel case.

Strap it on and get ready for the compliments. The *1938 Majestic* secures with a black leather strap and is water-resistant to 3 ATMs.

Your satisfaction is 100% guaranteed. We invite you to try the *Stauer 1938 Majestic* for 30 days. We're confident that it will captivate you, but if for any reason it doesn't, send the watch back within 30 days for a prompt and courteous refund. Please keep in mind that even Stauer can't keep a blockbuster like this in production forever. If you miss this chance to secure a piece of watchmaking history, you might just have to wait around for the sequel!

WATCH SPECS:

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Gaudí's Masterpiece

When the pope said Mass there this fall, the Sagrada Família was already 128 years in the making—and still not finished. Yet the church's nature-inspired design remains ahead of its time.



"MY CLIENT IS NOT IN A HURRY," Antoni Gaudí used to say. The pious architect was speaking of God, explaining why the Roman Catholic Sagrada Família church was taking so long to complete. Nearly a century later it remains ■ work in progress—a dream of spires and ornate facades rising hundreds of feet above downtown Barcelona, drawing the eyes (and euros) of some two million visitors a year. This November Pope Benedict XVI consecrated it as a basilica. A final completion date of 2026 appears likely. And if history begets history, the time is ripe to reappraise Gaudí's epic endeavor—and the prescient ideas behind it.

The Sagrada Família has always been revered and reviled. The surrealists claimed Gaudí as one of their own, while George Orwell called the church "one of the most hideous buildings in the world." As idiosyncratic as Gaudí himself, it



is a vision inspired by the architect's religious faith and love of nature. He understood that the natural world is rife with curved forms, not straight lines. And he noticed that natural construction tends to favor sinewy materials such as wood, muscle, and tendon. With these organic models in mind, Gaudí

based his buildings on a simple premise: If nature is the work of God, and if architectural forms are derived from nature, then the best way to honor God is to design buildings based on his work. As the Barcelona scholar Joan Bassegoda Nonell notes, "Gaudí's famous phrase, 'originality is returning to the origin,' means that the origin of all things is nature, created by God." Gaudí's faith was his own. But his belief in the beautiful efficiency of natural engineering clearly anticipated the modern science of biomimetics.

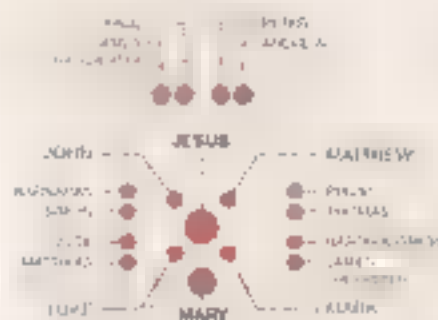
Born in 1852 near the town of Reus, (Continued)

Barcelona's Natural Wonder

Financed entirely through private donations and tourist revenue, the Sagrada Família is inching closer to completion. A look at the church's layout and design reveals a marvel of imaginative—and unprecedented—engineering.

Symbolic Towers

Still unconstructed, the church's primary pillars will represent some of Christianity's most important figures: Jesus, Mary, the Gospel writers.

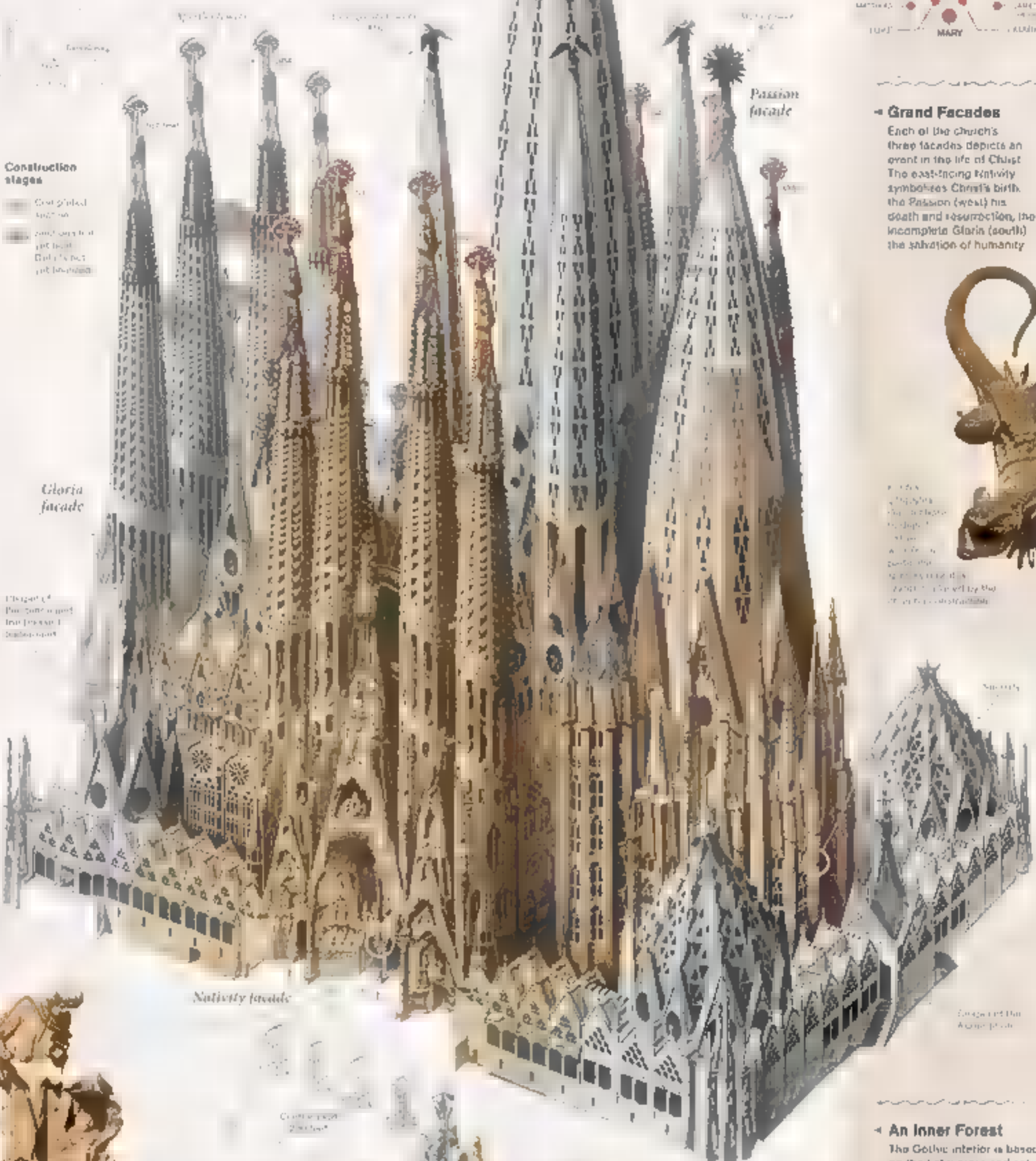


Grand Facades

Each of the church's three facades depicts an event in the life of Christ. The east-facing Nativity symbolizes Christ's birth, the Passion (west) his death and resurrection, the incomplete Gloria (south) the salvation of humanity.



The lizard sculpture is a detail from the Passion facade, designed by Gaudi.



Construction stages
 Completed
 Under construction
 Not yet started

Gloria facade

Design of the tower is based on the cross.

Nativity facade

Passion facade

An Inner Forest

The Gothic interior is based on the Latin cross and set by initial architect Francisco del Villar. But Gaudi wanted the space to feel like a *skyline canopy*. Columns rise like tree trunks before branching. Light is captured and reflected through a double roof.



The double roof is designed to capture light and reflect it through the canopy.



NATIONAL GEOGRAPHIC

ART: THE SAGRADA FAMILIA IS A MASTERWORK OF Gaudi's architecture. The church's design is a blend of Gothic and Art Nouveau styles. The facade is a masterpiece of sculpture and architecture. The church is a symbol of Barcelona's identity and a source of pride for its people.

A Work in Progress

Here are some key steps in the church's slow march to completion.

- 1883** Eleven years after the first stone was laid, the church's crypt and apse are finalized.
- 1933** The Nativity facade—which Gaudi intended as the church's structural and decorative template—is completed.
- 1976** The Passion towers are completed. Later, sculptor Josep Maria Subirachs begins the facade.
- 2010** Designed by Gaudi to both capture and distribute light, the central nave's vaulting is completed.
- 2020** The church's main towers are slated to be finished. This will nearly double the structure's total height.
- 2026** After 144 years, work on the Sagrada Família will be completed.

1883 Gaudi becomes chief architect of the church. **1926** Gaudi dies in Barcelona. **1936** The Spanish Civil War begins. Many of Gaudi's 3-D models are burned. **1939** The civil war ends. Construction begins again based on remaining models. **1992** Barcelona hosts the Summer Olympics, boosting church revenue via tourism. **2010** Pope Benedict XVI consecrates the basilica.

Design by Nature

Antoni Gaudi pioneered an architecture based on nature's geometric forms. Structural and ornamental, they reflect his native region—and ingenuity.



Structures

Having observed their functional perfection in nature, Gaudi used twisted surfaces and curved planes as the organic bases of his buildings. His columns, arches, and stairways all stem from this notion of natural design.

Columns

In his quest for a perfect column, Gaudi studied the helical growth of many plants—patterns that let leaves receive sunlight and lend structural strength.



Helical growth patterns in a plant stem.

How It Works

Gaudi's columns follow the natural weight-distribution pattern of trees. Beginning with an eight-sided polygon and following the logic of a double-twisting helical column, gain sides and strength with height.

Helical growth patterns in a plant stem.



THE STATUS QUO

At the beginning of the project, Gaudi designed a column with 8 sides. As the column grew taller, it needed to support more weight. To do this, Gaudi added sides to the column as it grew taller.

Process of the column's growth.

Top view

Architectural drawing of a column.

Column growth pattern.

GAUDI'S RESPONSE

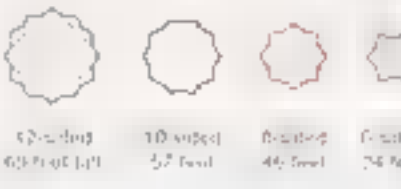
Gaudi's response to the status quo was to create a column that grew taller and stronger. He did this by adding sides to the column as it grew taller. This created a column that was stronger and more stable.

Column growth pattern.

Top view

Architectural drawing of a column.

The main column of the Sagrada Família grows in 8 sides and stays at 8 sides for the first 10 meters. The diameter and number of sides increase as the column grows taller to bear the load the column needs to bear.



Column growth pattern.



Repeating workers lend a sense of scale to the church's central nave vaulting.

Ornaments

Gaudi's sense of aesthetic beauty was directly tied to physical utility. If perfect practicality arises in the natural world, he concluded, so too must sublime decoration.

Other Structures

Arches Follow Gravity
All of Gaudi's works feature catenary arches, which form naturally via gravity and are stable when a rope is hung to determine the load capabilities of the church's arches. Gaudi hung proportionally measured sacks of lead

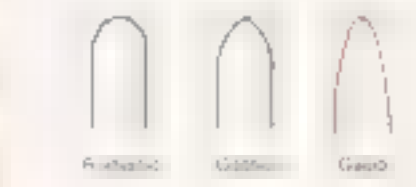
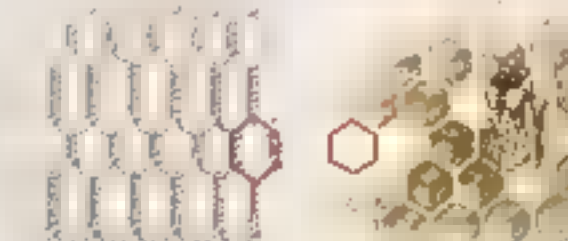


Diagram showing the use of lead sacks to determine arch load capabilities.

Honeycomb Gates

The patterns of honeycombs and palm fronds are etched on the gates, walls, and floors of many of Gaudi's early architectural works.



Honeycomb patterns on a wall.

Vine Lines

Gaudi often incorporated naturally spiraling helices. Passion fruit tendrils, for instance, adorn the side walls of the Nativity facade.



Organic Windows

Following the patterns found on natural objects, like those on a marine diatom, Gaudi designed windows to allow for greater passage of natural light.



Organic window design.

Double Roof

A unique feature of the church's roof, quadric surfaces called hyperboloids reflect and filter natural light.

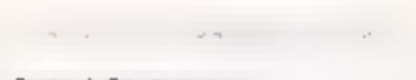
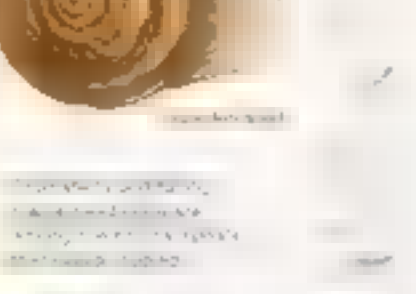


Diagram of a hyperboloid roof structure.

Spiral Stairways

Found in plants, animals, and planetary systems, spirals are a recurring shape and theme in Gaudi's works.



Spiral staircase in a building.

Leaflike Roofs

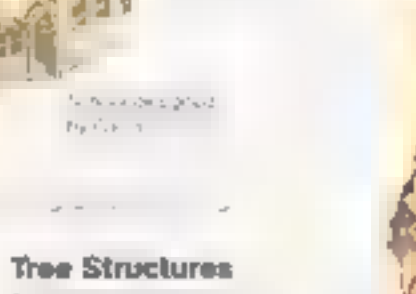
Taken from the structure of a leaf and applied to a roof design, a curved plane called a conoid bears great weight and can channel rainwater.



Leaflike roof structure.

Tree Structures

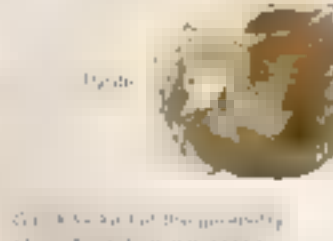
To create the church's inner forest, Gaudi etched tree features into his columns. The crown of the central nave represents the transition between the trunk and branches of a great tree.



Tree structure diagram.

Pinnacles of Detail

The tower tops of the Sagrada Família are modeled on the architect's study of crystals, carnal grain spikes, and grasses growing in and around Barcelona.



Tower pinnacle detail.

Barcelona



Barcelona's Architect

Most of Gaudi's works are found in or around Barcelona. They have become symbols of both the city and the region of Catalonia.

Gaudi's Works

- 1 Sagrada Família
- 2 Casa Vicens
- 3 Casa Güell
- 4 Park Güell
- 5 Col·legi de les Teresianes
- 6 Casa Calvet
- 7 Crypt of the Colonia Güell
- 8 Batlló
- 9 Park Güell
- 10 Casa Milà
- 11 Casa Batlló
- 12 Casa de la Colla
- 13 El Capricó de Cornudà
- 14 Palau Episcopal de Astorga
- 15 Casa de les Botines de León
- 16 Casa Güell
- 17 Museu de Girona
- 18 Catedral de Palma de Mallorca



2000 The central nave vaulting is completed in the decade since technological advances have sped progress.

THE BIG IDEA



2010 The Sagrada Família soars above the plazas and *avenidas* of Barcelona, defining the downtown skyline.

Gaudí grew up fascinated by geometry and the natural wonders of the Catalan countryside. After architecture school, he eventually forged his own style—a synthesis of neo-Gothic, art nouveau, and Eastern elements. For Gaudí, form and function were inseparable; one found aesthetic beauty only after seeking structural efficiency, which rules the natural world. “Nothing is art if it does not come from nature,” he concluded.

In 1883 Gaudí inherited the Sagrada Família from another architect, who had laid a traditional neo-Gothic base. Gaudí envisioned a soaring visual narrative of Christ’s life, but knew that the massive project could not be completed in his lifetime. For more than 12 years prior to his death in 1926—he spent his last year living at the site—he rendered his plans as geometric three-dimensional models rather than as conventional drawings. Though many were destroyed by vandals during the Spanish Civil War, those models have been vital to Gaudí’s successors.

“They contain the entire building’s structural DNA,” explains Mark Burry, an Australia-based architect who has worked on the Sagrada Família

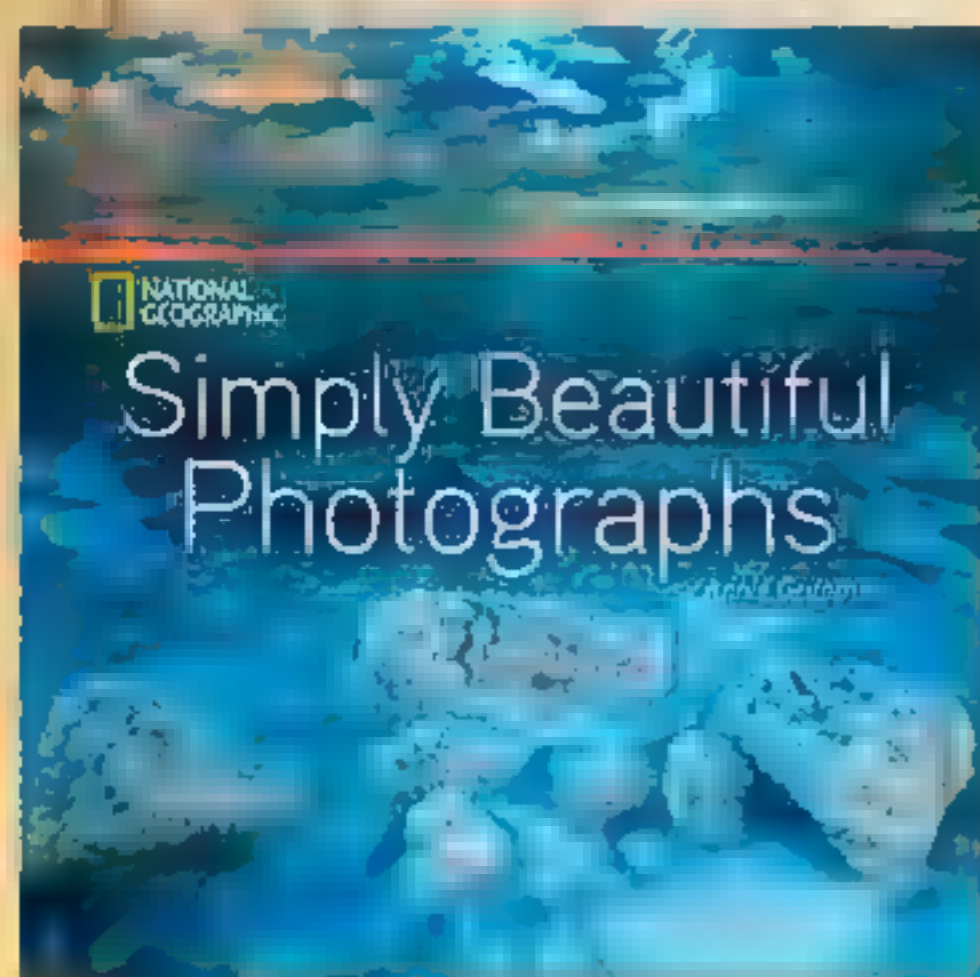
for 31 years, using drawings and computer technology to help translate Gaudí’s designs for today’s craftsmen. “You can extract the architectural whole even from fragments. The models are how Gaudí met the architect’s challenge: taking a complex, holistic idea and explicating it so others can understand and continue it after your death.”

Adrian Bejan says the facades of the Sagrada Família are based on the golden ratio, the geometric proportion “behind all aesthetically pleasing art.” The distinguished professor of mechanical engineering at Duke University, whose “constructal law” states that design in nature is a universal phenomenon of physics, calls Gaudí a forebear and a “tightrope walker on the line bridging art and science. He understood that nature is constructed by laws of mathematics. What is strongest is inherently lightest and most efficient, and therefore most beautiful.”

At the heart of Gaudí’s vision is a timeless truth. As Bassegoda writes: “Looking toward the future, the lesson of Gaudí is not to copy his solutions but rather to look at nature for inspiration... nature does not go out of fashion.” —Jeremy Berlin

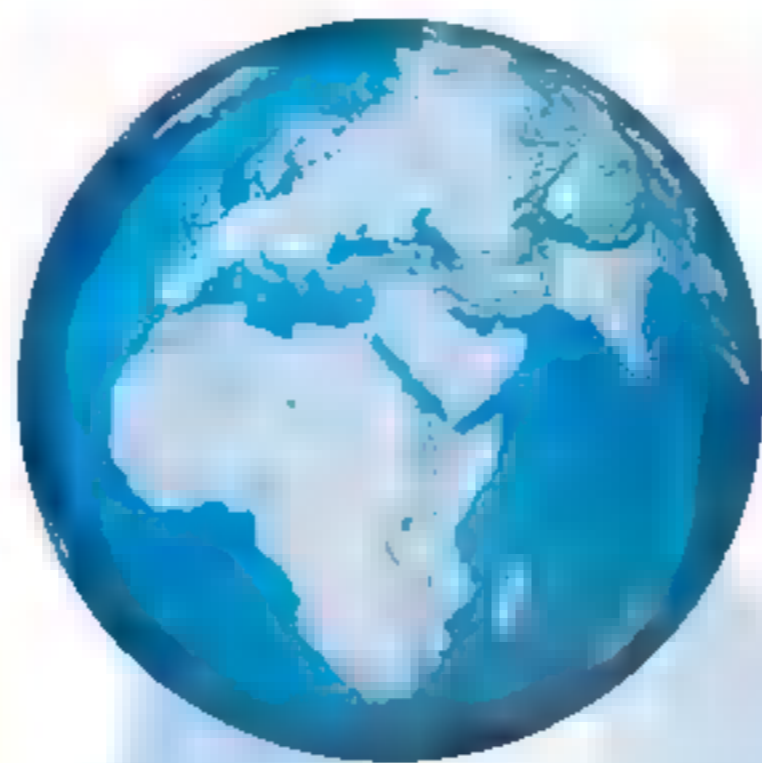
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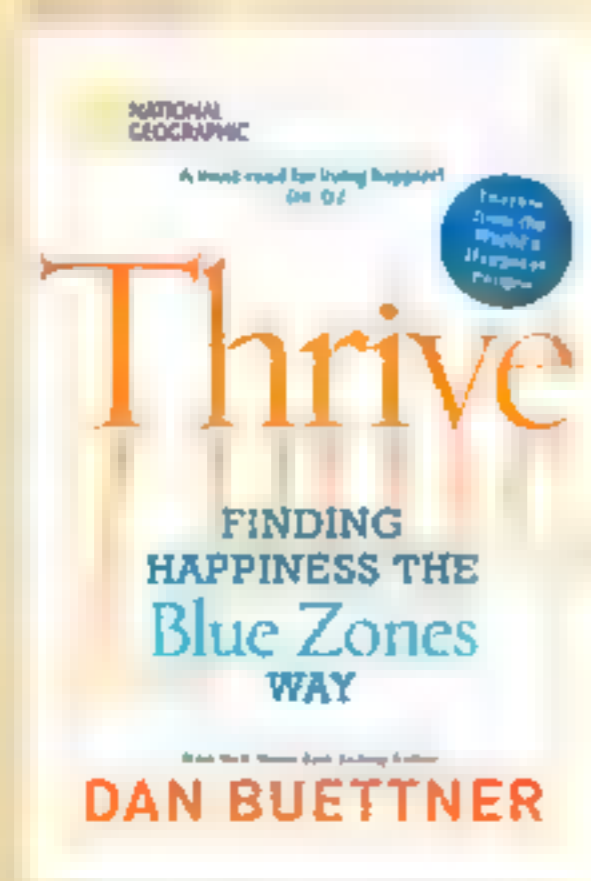
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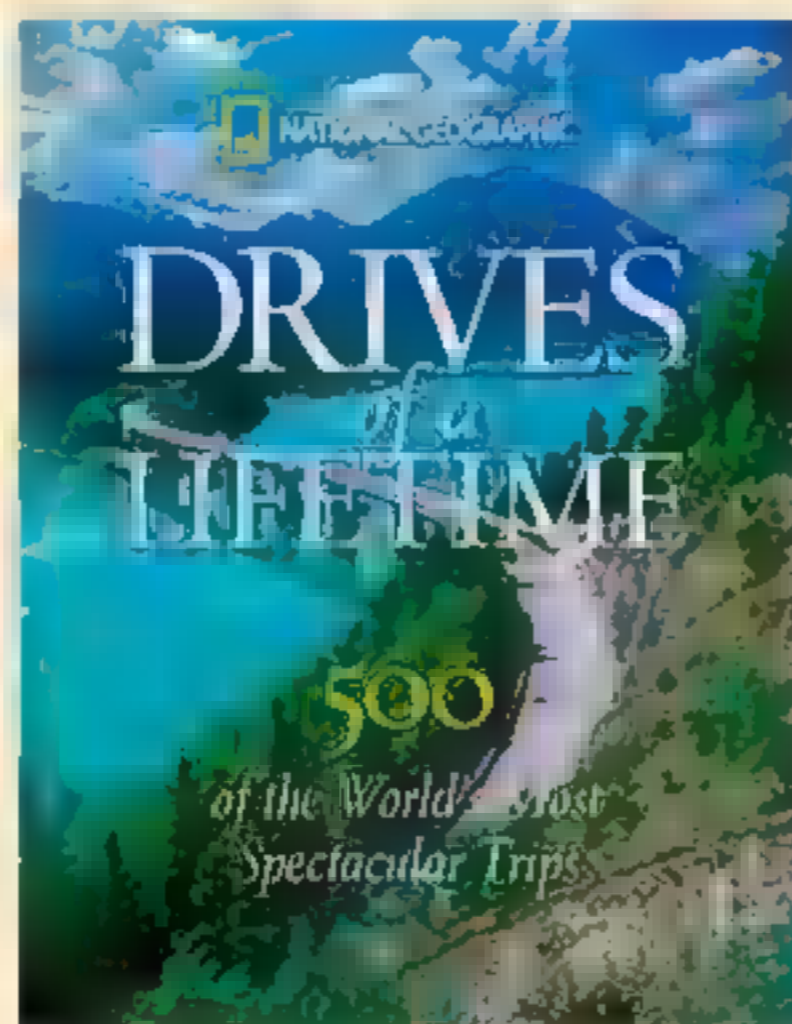
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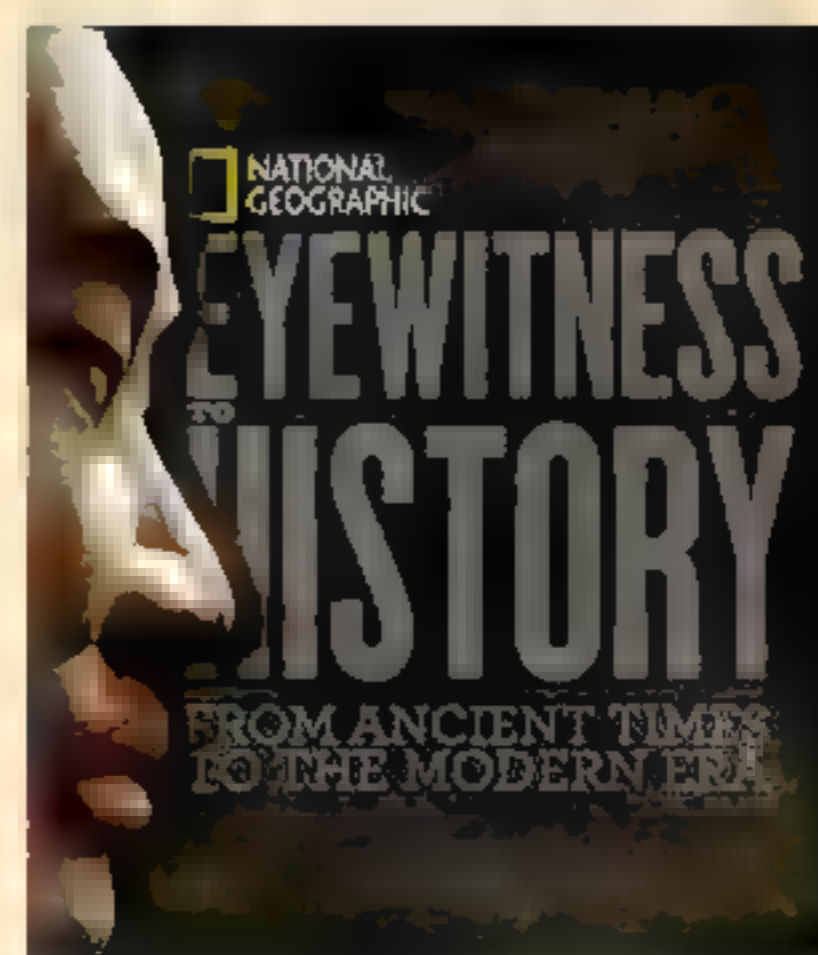
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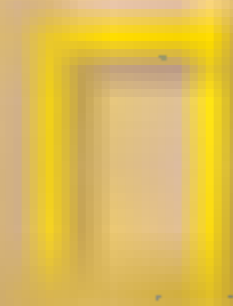
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AFGHAN WOMEN SUFFER
UNDER THE CONSTRAINTS OF
TRIBALISM, POVERTY, AND
WAR. NOW THEY ARE STARTING
TO FIGHT FOR A JUST LIFE.



Unafraid to rally

My first time in Afghanistan, the Taliban ruled the country. The only women on the street were beggars—usually widows or wives of disabled men. On many Fridays the Taliban performed public executions at the sports stadium in Kabul. Ten years later, at a rally for a presidential candidate in the same stadium, women participated—some in burkas, some not. In this picture, the women who did not want to be photographed covered their faces.

■ labor on the road

Preceding pages: I saw two women on the side of the mountain, in burkas and without a man. In Afghanistan you seldom see an unaccompanied woman. Noor Nisa, about 18, was pregnant; her water had just broken. Her husband, whose first wife had died during childbirth, was determined to get Noor Nisa to the hospital in Faizabad, a four-hour drive from their village in Badakhshan Province. His borrowed car broke down, so he went to find another vehicle. I ended up taking Noor Nisa, her mother, and her husband to the hospital, where she delivered a baby girl. My interpreter, who is a doctor, and I were on a mission to photograph maternal health and mortality issues, only to find the entire story waiting for us along a dusty Afghan road.

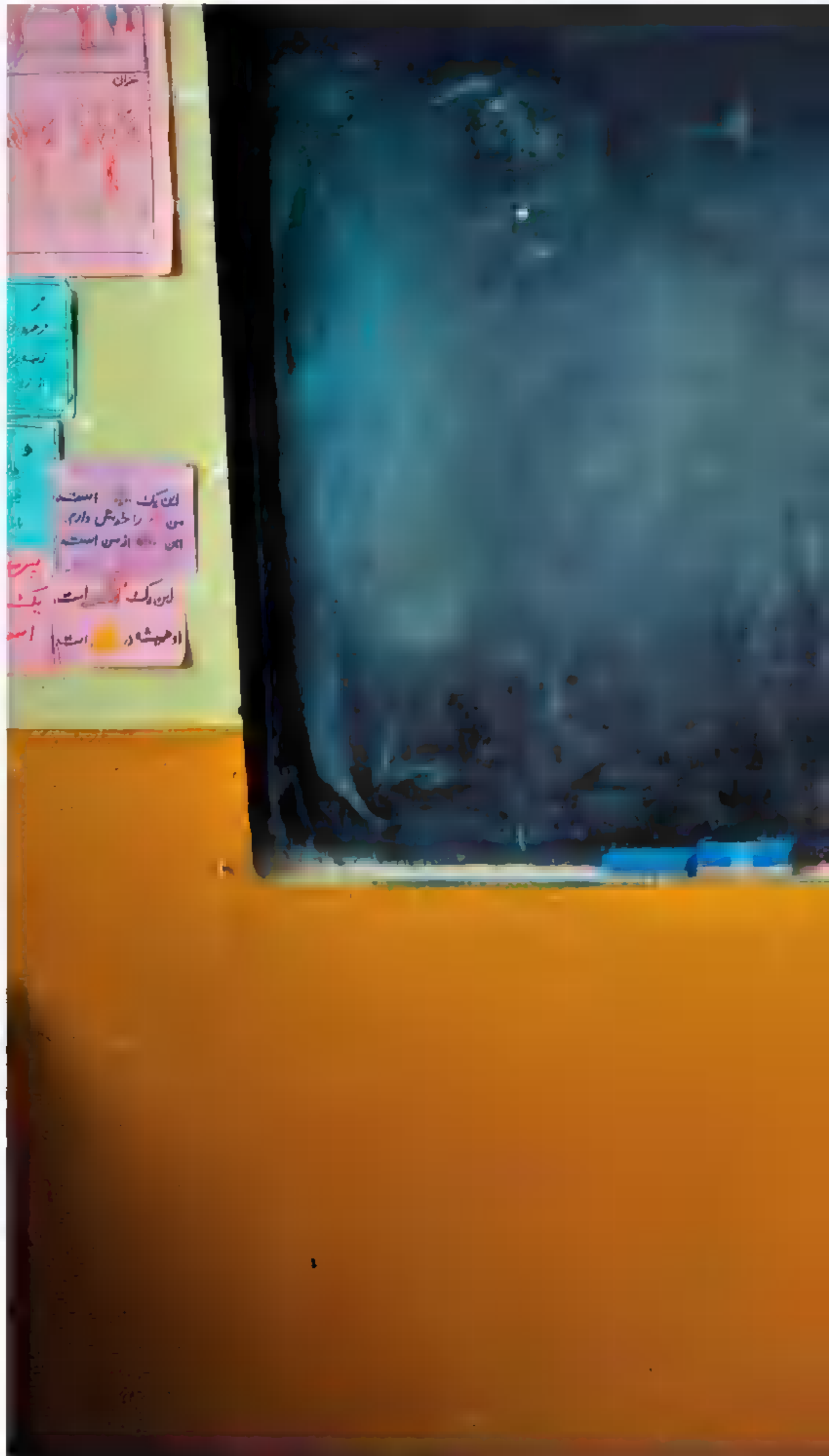


LYNSEY ADDARIO first traveled to Afghanistan in 2000, photographing life under Taliban rule. Her work there and elsewhere, often focusing on the challenges that women face, earned her a prestigious MacArthur Foundation Fellowship in 2009. The photos for this story were made over eight weeks in 2009 and 2010; her comments tell the stories behind the images.



Setting herself ablaze

"I took the bottle of petrol and burned myself," Fariba, who is 11 and lives in Herat, told me. "When I returned to school, the kids made fun of me. They said I was ugly." She now says, "I regret my mistake." The reasons for her action are unclear; Fariba claimed a woman came to her in her dreams and told her to burn herself. Many Afghan women burn themselves because they believe suicide is the only escape from an abusive marriage, abusive family members, poverty, or the stress of war. If they do survive, women fear being shamed or punished for what they did and may blame a gas explosion when they were cooking. Doctors know when the burns were intentional from their shape, location, and smell.



An estimated 2,300 women or girls attempt suicide each year. Many set themselves on fire as a way to escape domestic violence.



A fortunate new mother

After traveling in remote areas where most women give birth at home, without even a midwife, I was relieved to visit the hospital in Faizabad, provincial capital. The hospital's women doctors, nurses, and midwives work around the clock. These Afghan women, who trained both in Russia and Kabul, have the skills and equipment to deal with complications in childbirth, even though they barely have enough funds for rubber gloves and gowns. I photographed Kokogol, 25, delivering twins, with her mother by her side.





Twenty-five years ago an Afghan girl with green eyes haunted the

cover of *National Geographic*. She became the iconic image of Afghanistan's plight, a young refugee fleeing the war between the Soviet-backed communists and the American-backed mujahideen. Today the iconic image of Afghanistan is again a young woman—Bibi Aisha (page 39), whose husband slashed off her nose and ears as punishment for running away from him and his family. Aisha fled to escape beatings and other abuse.

Why do husbands, fathers, brothers-in-law, even mothers-in-law brutalize the women in their families? Are these violent acts the consequence of a traditional society suddenly, after years of isolation and so much war, being hurled into the 21st century? And which Afghans in this society are committing the violence? There are significant differences between the Hazaras, Tajiks, Uzbeks, and Pashtuns, the most populous and conservative group and the one that has dominated political life since the 1880s.

In the Pashtun crescent, from Farah Province in the west to Kunar in the northeast, life was—and in many ways still is—organized around the code known as *Pashtunwali*, the “way of the Pashtun.” The foundation of *Pashtunwali* is a man's honor, judged by three possessions—*zar* (gold), *zamin* (land), and *zan* (women). The principles on which the honorable life is built are *melmastia* (hospitality), *nanawati* (shelter or asylum), and *badal* (justice or revenge).

Elizabeth Rubin is a contributing writer for the New York Times Magazine. Photojournalist Lynsey Addario is based in New Delhi, India.

The greater a Pashtun man's hospitality, the more honor he accrues. If a stranger or an enemy turns up on his doorstep and asks for shelter, his honor depends on taking that person in. If any injury is done to a man's land, women, or gold, it is a matter of honor for him to exact revenge. A man without honor is a man without a shadow, without assets, without dignity.

But it is not generally acceptable for Pashtun women to extend hospitality or exact revenge. They are rarely agents. They're assets to be traded and fought over—until they can stand it no longer.

At a shelter in Kabul for women who have escaped domestic abuse, I heard about a girl from one of the richest Pashtun families in a province bordering Pakistan. She fell in love with a boy from the wrong tribe. Her father killed the boy and four of his brothers, and when he discovered that his own mother had helped his daughter escape her father's wrath, he killed his mother too. Now he is offering a \$100,000 reward for his daughter's dead body.

These are extreme actions by an extreme man. But many Pashtun men perceive that their manhood and very way of life are under assault—by a foreign military, foreign religious leaders, foreign television, international human rights groups—and they hold fast to traditions that for so long have defined what it means to be a Pashtun man.

ONE DAY IN A KABUL BOOKSTORE I found a collection of *landays*—“short ones”—the two-line poems the Pashtuns recite to each other at the village well or at wedding celebrations. The book, originally published as *Suicide and Song*, was compiled by Sayd Bahodine Majrouh, a celebrated Afghan poet and writer assassinated while in exile in Pakistan in 1988. He first collected women's *landays* in his native Kunar River Valley. Majrouh, a humanist, found glory in these cries from the heart, which defy convention and in many ways mock male honor. From cradle to grave, the Pashtun woman's lot is one of shame and sadness. She is taught that she is undeserving of love. This is why, Majrouh wrote, *landays* are “a cry of separation” from the idea of love and a revelation of the misery of misalliance.

A woman's husband is often either a child or an old man forced on her through tribal bonds:

*Have you with your white beard no shame?
You caress my hair and inside myself I laugh.*

Tauntingly, a woman lances a man's virility:

*In battle today my lover turned his back to
the enemy. / I am ashamed of having kissed
him last night.*

Or voices her frustrated desire:

*Come, my beloved, come quickly and be
close to me! / The "little horror" lies in
slumber and you may kiss me now.*

The "little horror" is the man a woman is forced to marry, a kind of dupe. Only without his knowledge will she find true love. As Majrouh understood them, Pashtun women, for all their submissiveness, have always lived in a state of deep craving for rebellion and for the pleasures of earthly life. He called his book *Suicide and Song* because these two acts are how they protest their anguish. In Majrouh's time the two methods of suicide were poison and drowning. Now they are poison and self-immolation.

THE AFGHAN PARLIAMENT recently drafted a law intended to eliminate violence against women, who are beginning to reject old cultural practices and assert themselves in public and in private. I went to the Kabul home of Sahera Sharif, a Pashtun and the first female member of parliament from Khost. "No one knew a woman could put up campaign photos and posters on the walls in Khost—men didn't allow women to even have jobs in Khost," she said.

As a girl, Sharif stood up to her father, a conservative mullah, locking herself in a closet until he allowed her to go to school. She lived through the civil war between competing mujahideen groups, who ravaged Kabul before the Taliban conquest in 1996. She witnessed unimaginable cruelty and many deaths. "Much of the violence and cruelty you see now," Sharif said, "is because people are crazy from all these wars."

After the Taliban fell in December 2001, Sharif started a radio station to educate women about

hygiene and basic health. More radically, she volunteered to teach at the university in Khost (a first there). She took off her burka (another first) and stood before the male students teaching them psychology. They blushed. And so she began to reeducate them.

As we talked, I could see what an inspiration Sahera Sharif has been to her 15-year-old daughter, Shkola, who interrupted her mother to show me a photograph of a woman in a magazine. The woman was lying with her throat cut, murdered by her husband's family. The woman's mother, mad with grief, had begged the magazine to publish the photograph. "I became crazy from this picture," Shkola said. "I saw it over and over like a film."

Shkola is studying Islamic history and law. She intends to become a lawyer in order to help women defend themselves against violence and injustice. In the meantime, she is scouring books from Iran to find stories for children "like you have," she said. "We have almost none here. So I'm translating them into Pashtu, and I'm also writing a novel."

In various corners of the country—in Khost and Kandahar, in Herat and Kabul—I've met young women like Shkola. They're writing not the old landays but poems and novels, and they're making documentaries and feature films. These are the new stories women are telling about their lives in Afghanistan. □





Praying with tears

In Herat the shrine to Shahzada Qasim, a descendant of the Prophet Muhammad, is more than a thousand years old. One day of each week a section is partitioned so women can come to worship. Cordoned off to create a sanctuary for women, these prayer sections seem to me like some of the safest, most intimate places in the country. The women at the shrine in Herat are enveloped in chadors that cover them from head to foot, influenced by the style favored in neighboring Iran. In this shrine and in shrines throughout Afghanistan, some of the women weep uncontrollably. I always wonder why they are crying. Perhaps because of the deeply emotional nature of public prayer and the holiness of the place?

In eight out of ten cases, a family member is responsible for a violent attack on a woman.



Scarred for life

Bibi Aisha was 19 when I met her in Kabul's Women for Afghan Women shelter in November 2009. Her husband beat her from the day she was married, at age 12. When he beat her so badly she thought she might die, she escaped to seek a neighbor's help. To punish her for leaving without permission, her husband, who is a Taliban fighter, took her to a remote spot in the mountains. Several men held her while he cut off her nose, ears, and hair. She screamed—to no avail. "If I had the power, I would kill them all," she told me. I wanted to be strong for Aisha to give her hope she would be fine again. But when she described that moment, I began to cry. Aisha arrived in the U.S. in August for extensive reconstructive surgery.

An emerald bride

It's very delicate to photograph an Afghan wedding. The women are unveiled and often wear revealing dresses and heavy makeup. They are reluctant to share these images with the outside world. At this Kabul wedding the bride is Fershta, 18. She wears a green dress for the ceremony—a color associated with prosperity and paradise in Islamic tradition. The groom is Amin Shaheen, son of film director Salim Shaheen. The sober expression on his wife's face reflects the fact that marriage is an enormous milestone in an Afghan woman's life, not just a celebratory event.





Daring to drive

With face, hair, and arms in full view, actress Trena Amiri chauffeurs a friend around Kabul on a Friday. She blasts her favorite songs off a cassette and shimmies and sings along, tapping the steering wheel as she dances in the driver's seat. Even in relatively progressive Kabul, men and women glare, honk, and scream at her. It provokes men in Afghanistan to see strong women. It symbolizes a freedom they just aren't comfortable with. Amiri fled her husband of seven years, who, she says, kept her home and beat her. She left her three sons behind. She doesn't plan to remarry but knows she might have to in order to survive in Afghanistan, where women are dependent on men for so many things. When I ask about her current boyfriend, whose name is on the gold bracelet around her wrist, she says she couldn't marry him: "He won't let me act anymore, and I want to continue my art."



From April 2007 to October 2009, Kabul issued 180 driving permits to women. The total for men: 27,985.





Dreaming of Olympic glory

These young Afghan women are part of a team that will compete at the 2012 Summer Olympic Games in London, where women's boxing will debut as an official sport. The athletes triumphed just by getting their families to sign on to the idea of their daughters participating in sports. During matches in public venues, the members of the Oxfam-supported team, now competing in South Asia, cover their hair with *hijab* worn beneath their head guards. That's not a problem for the International Boxing Association, as long as the boxer's face is clearly visible. Here, practicing indoors in Kabul, they can go bareheaded.

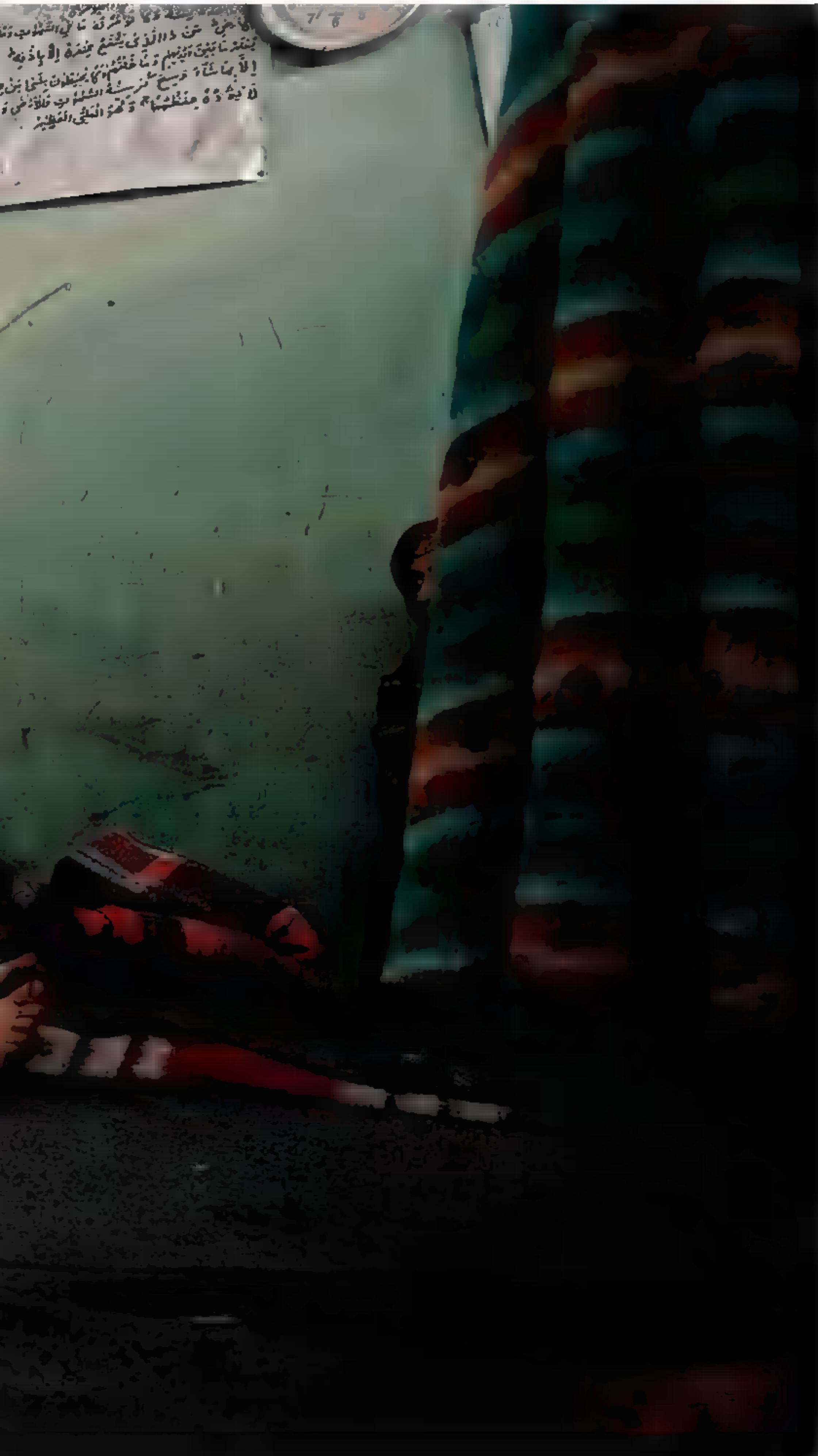


Training day for policewomen

Afghan policewomen handle AMD-65 rifles at a dusty firing range outside Kabul. They are trained by carabinieri, Italian military police from the local NATO troops. Joining the police force is ■ bold decision for an Afghan woman. Insurgents often attack the police. Very few women get permission to sign up from their husband and male relatives. Of 100,000 officers, only about 700 are female. Yet women are welcome recruits. They can take on tasks that men cannot because of Islamic custom: frisking other women, searching homes where female family members are present. Many who take the job are widows of fallen officers cast in the role of breadwinner. The pay is about \$165 ■ month.

About half of the country's 476 female prisoners are in jail for "moral crimes."





The wails of a jailed wife

A female inmate at a Mazar-e Sharif prison has just been released, prompting Maida-Khal, 22, to cry out because she is still trapped in her cell. When Maida-Khal was 12, she was married to a man of about 70 who was paralyzed. "I was so young, I couldn't carry him because he was so heavy, so his brothers would beat me," she recalls. When she asked for a divorce four years ago, she was imprisoned. "I am in jail because I don't have a *mahram* [male guardian]. I can't get a divorce, and I can't leave prison without a man." She says, with remarkable understatement, "I have had a difficult life."





A teacher's trek

All village women are invited to come to health and hygiene classes taught by a traveling midwife—wearing a white hijab and glasses in this photograph. She works for a mobile clinic sponsored by the United Nations Population Fund and the international medical relief group Merlin, which brings pre- and postnatal care to women in isolated villages like this one in northeastern Badakhshan Province. She travels with a male nurse, who gives routine checkups to the kids.

Unusual graduates

Many girls in Afghanistan get no education at all. Even those who do enroll in school typically study for just four years. So these members of Kabul University's class of 2010 are definitely in the minority. Wearing hijab under their mortarboards and seated in separate rows from their male peers, the women pictured are graduates of the department of language and literature. The Taliban had banned the education of women, but classes resumed after the regime fell in 2001. This graduation was held under tight security at a hotel in Kabul because of an upsurge in terrorist attacks.



The literacy rate for Afghanistan's women is 18 percent. The rate for men: 36 percent.







Dolled-up wedding guests

These two girls have been dressed up and made up for a relative's wedding in Kabul. Many Afghan women and girls put on makeup and spend hours at the hair salon for such an occasion. Young girls are able to show off their makeovers. But once a girl arrives at the age of puberty, she masks herself from men with a burka or hijab.



SWAN SERENADE

With its eight-foot wingspan, the whooper is a jumbo jet in the avian fleet of waterfowl. By turns angelic in flight, flashy in a display of triumph (above), stately in tucked-in repose (right), it is elegance on the wing—a bird to inspire flights of fancy.



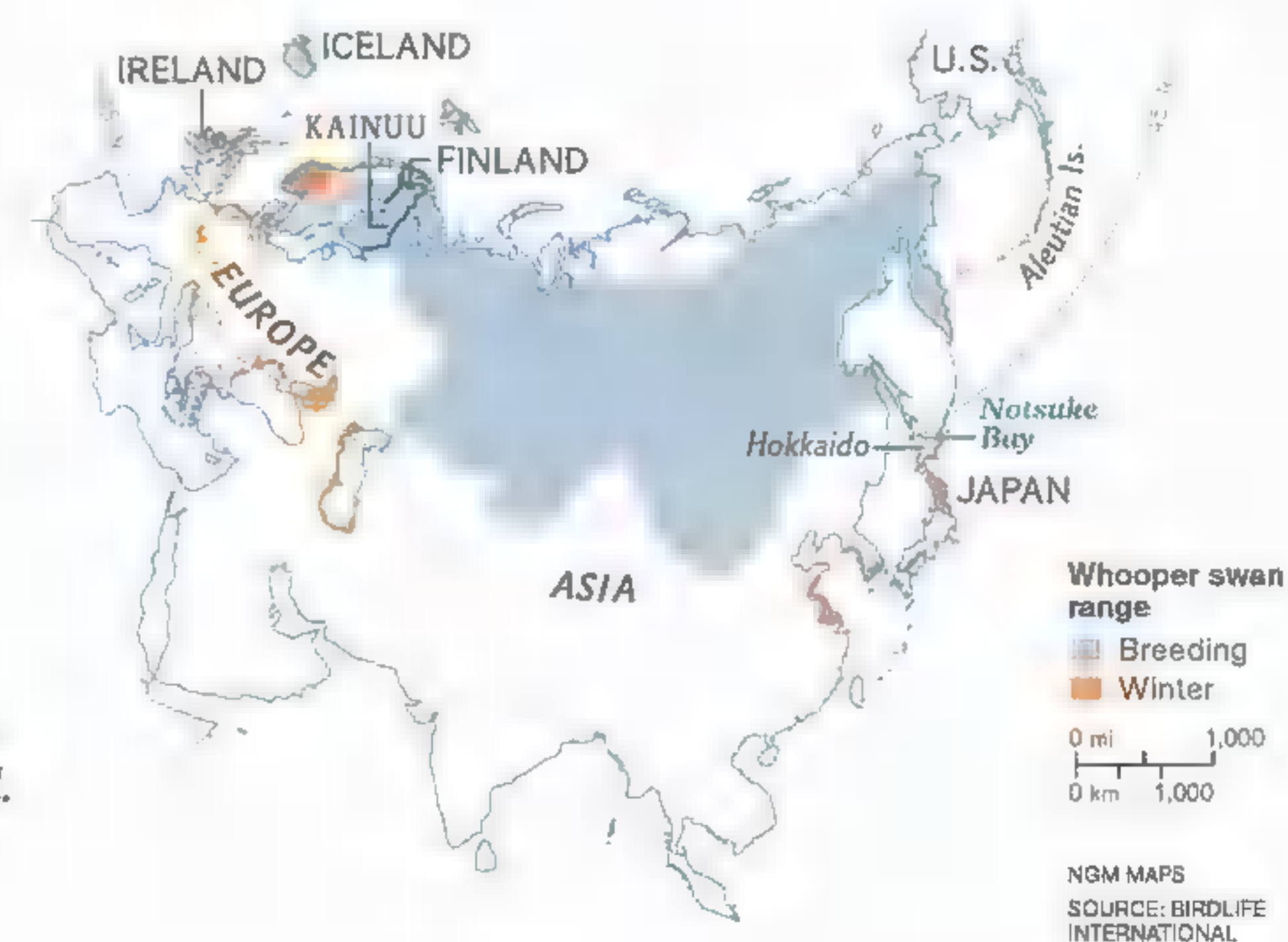
From the swirl of its initial letter to its sighing vowel and feather-soft final consonant, the very word—"swan"—suggests grace. Peter Ilich Tchaikovsky did not, after all, write *Duck Pond*. The whooper swan, like its onomatopoeic cousins, the whistling and the trumpeter, belongs to an elegant society of sisters; the mute, Bewick's, black, and black-necked fill out the ranks. First described by Carl Linnaeus in 1758, *Cygnus cygnus* can be considered a swan among swans, the type species, hence archetype, of all swans. It is also a swan of superlatives. With a population of about 180,000, the whooper, though vulnerable to loss of habitat, is among the most abundant of swans and trumps others in the sweep of its range.

To the ancients, the appearance of a swan, with its effortless glide on the mirror of a lake and lovely, unfurling flight, signaled evanescence and evoked immortal longings. Socrates, Plato tells us, heard the song of a swan on the day of his death. The Valkyries, in the guise of swans, bore their fallen heroes to the Valhalla of Norse mythology. Pythagoras believed the souls of poets passed into swans, a fitting entombment that turns the tattered phrase "poetry in motion" into a truly lyrical trope.

The swan, Russian poet Anna Akhmatova writes, "floats through the centuries" and into the turning wheel of seasons. Swans on their autumnal migratory flight—the celestial flutter of wings, the silver arrow of a flock splitting the sky—evoke poetic melancholy. Shadows lengthen. Days shorten. Another year closes in. Still, there is the reassuring uplift of fairy tales like Hans Christian Andersen's duckling turned swan, with its metamorphosis from plain to princely.

Bittersweet, these beautiful birds. Yet their loveliness masks the toll exacted by the gravitational pull of their large bodies and the strain of daily survival. Labored takeoffs, the frantic paddling of webbed feet and heavy beating of wings before their soaring ascent, a territorial aggressiveness directed at other swans and waterfowl that can turn vicious and, occasionally, deadly, suggest that beauty does not come as easily or kindly as we might wish. —Cathy Newman

Stefano Unterthiner's book about whooper swans, The Angels of Winter, was published in Italy this year.



A pair of whoopers on Hokkaido, Japan, face off. Breeding territory spans half the globe, from Iceland to the Aleutians. Migration begins in the latter half of September; they return north in March and April.



A parent swan in the Kainuu region at the eastern edge of Finland shepherds its cygnets (top), which hatch in June. A couple (above) call at another bird that has invaded their territory. Nests, built of mud, moss, and grass, may be refurbished and reused in subsequent years.

Born down-covered and open-eyed, the young benefit from the vigilant surveillance of both parents (top). Within a few days they venture from the nest to forage for aquatic plants and insects (above). They join their parents for fall migration and stay with them their first winter.

1. The first part of the text discusses the importance of maintaining accurate records of all transactions. It emphasizes that proper record-keeping is essential for the success of any business and for the protection of the interests of all parties involved.

2. The second part of the text focuses on the role of the auditor in ensuring the integrity of the financial statements. It highlights the need for auditors to exercise professional judgment and to maintain independence and objectivity throughout the audit process.

3. The third part of the text addresses the challenges faced by auditors in a complex and rapidly changing business environment. It discusses the need for auditors to stay current in their knowledge and skills and to adapt to new technologies and business models.

4. The fourth part of the text concludes by emphasizing the importance of transparency and accountability in the auditing process. It calls for a strong commitment to ethical standards and for a clear communication of the results of the audit to all stakeholders.





Pale as moonlight, whoopers settle down the night on a frozen stretch of Hokkaido's Notsuke Bay. "These birds aren't shy," says the photographer. Fed by humans, in some places they're a tourist draw. "Good for tourism, not the swans," a Japanese biologist says.









KINGS

OF CONTROVERSY

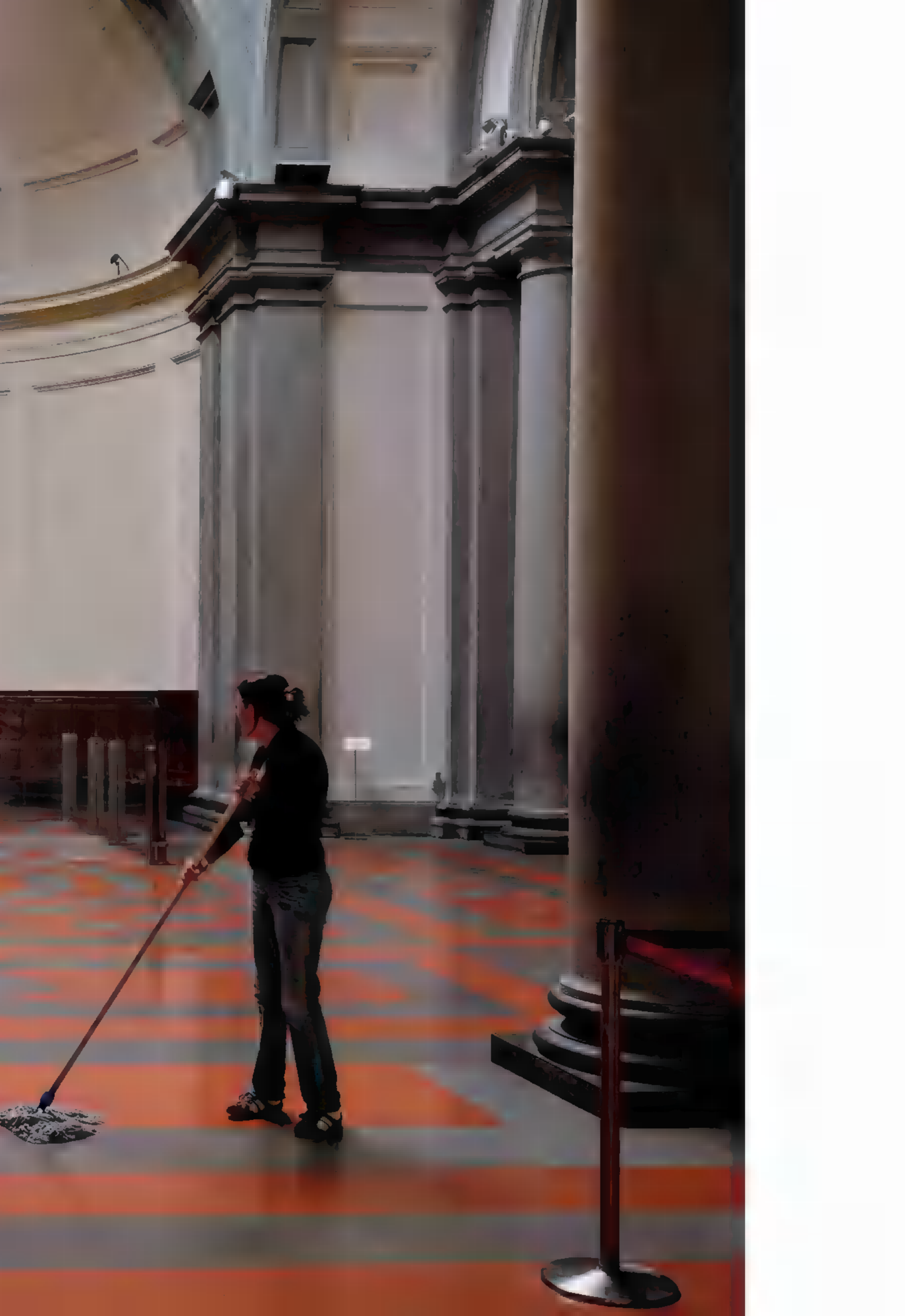
WAS THE
KINGDOM OF
DAVID
AND
SOLOMON
A GLORIOUS
EMPIRE—OR JUST
A LITTLE
COW TOWN?
IT DEPENDS
ON WHICH
ARCHAEOLOGIST
YOU ASK.

*A herder serenades his goats
near Jerusalem, a few miles from
where David tended his herds.*



In Michelangelo's famous rendering of David, the young warrior strikes a heroic pose as he prepares to battle the giant Goliath, a Philistine enemy of Israel. Whether David was a powerful king or simply a local shieftain is hotly debated among scholars.

PHOTOGRAPHED AT GALLERIA
DELLE ACCADEMIE IN FLORENCE, ITALY
WITH PERMISSION OF MINISTRY OF
HERITAGE AND CULTURE



Tourists explore Megiddo,
an ancient site north of
Jerusalem where archae-
ologists found ruins of
a palace and stables—
evoked by a metal-horse
sculpture. They were first
attributed to Solomon,
but evidence now suggests
the stables were built
at least a century after the
Babylonian he died.





BY ROBERT DRAPER
PHOTOGRAPHS
BY GREG GIRARD

THE WOMAN SITTING ON A BENCH IN THE OLD CITY OF JERUSALEM, ROUND-FACED AND BUNDLED UP AGAINST THE AUTUMN CHILL, CHEWS ON AN APPLE WHILE STUDYING THE BUILDING THAT HAS BROUGHT HER BOTH FAME AND AGGRAVATION. IT DOESN'T REALLY LOOK LIKE A BUILDING—JUST SOME LOW STONE

walls abutting an ancient terraced retaining wall 60 feet high. But because the woman is an archaeologist, and because this is her discovery, her eyes see what others might not. She sees the building's position, on a northern escarpment of the ancient city overlooking Jerusalem's Kidron Valley, and she imagines an ideal perch from which to survey a kingdom. She imagines the Phoenician carpenters and stonemasons who erected it in the tenth century B.C. She imagines as well the Babylonians who destroyed it four centuries later. Most of all, she imagines the man she believes commissioned and occupied the building. His name was David. This, she has declared to the world, is most likely the building described in the Second Book of Samuel: "King Hiram of Tyre sent... carpenters and masons, and they built a house for David. And David realized that the Lord had established him as king over Israel, and that He had exalted his kingdom for the sake of His people Israel."

The woman's name is Eilat Mazar. Munching and gazing, she is the picture of equanimity—until a tour guide shows up. He's a young Israeli man accompanied by a half dozen tourists who assemble in front of the bench so they can view the

building. The moment he opens his mouth, Mazar knows what's coming. The tour guide is a former archaeology student of hers. She's heard how he brings tourists to this spot and informs them that this is NOT the palace of David and that all the archaeological work at the City of David is a way for right-wing Israelis to expand the country's territorial claims and displace Palestinians.

Mazar jumps up from the bench and marches over to the tour guide. She chews him out in a staccato of Hebrew, while he stares passively at her. The gaping tourists watch her stalk off.

"You really need to be strong," she mutters as she walks. "It's like everyone wants to destroy what you do." And then, more plaintively: "Why? What did we do wrong?"

The archaeologist gets into her car. She looks stricken. "I feel like I'm really getting sick from stress," she says. "I've lost years from my life."

In no other part of the world does archaeology so closely resemble a contact sport. Eilat Mazar is one of the reasons why. Her announcement in 2005 that she believed she had unearthed the palace of King David amounted to a ringing defense of an old-school proposition under assault for more than a quarter century—

namely, that the Bible's depiction of the empire established under David and continued by his son Solomon is historically accurate. Mazar's claim has emboldened those Christians and Jews throughout the world who maintain that the Old Testament can and should be taken literally. Her purported discovery carries particular resonance in Israel, where the story of David and Solomon is interwoven with the Jews' historical claims to biblical Zion.

That narrative is familiar to any student of the Bible. A young shepherd named David from the tribe of Judah slays the giant Goliath from the enemy tribe of the Philistines, is elevated to king of Judah following the death of Saul at the close of the 11th century B.C., conquers Jerusalem, unites the people of Judah with the disparate Israelite tribes to the north, and thereupon amasses a royal dynasty that continues with Solomon well into the tenth century B.C. But while the Bible says David and Solomon built the kingdom of Israel into a powerful and prestigious empire stretching from the Mediterranean to the Jordan River, from Damascus to the Negev, there's a slight problem—namely, that despite decades of searching, archaeologists had found no solid evidence that David or Solomon ever built anything.

Then Mazar sounded her trumpet. "She knew what she was doing," says fellow Israeli archaeologist David Ilan of Hebrew Union College. "She waded into the fray purposefully, wanting to make a statement."

Ilan himself doubts that Mazar has found King David's palace. "My gut tells me this is an eighth- or ninth-century building," he says, constructed a hundred years or more after Solomon died in 930 B.C. More broadly, critics question Mazar's motives. They note that her excavation work was underwritten by two organizations—the City of David Foundation and the Shalem Center—dedicated to the assertion of Israel's territorial rights. And they scoff at Mazar's allegiance to the antiquated methods of her archaeological forebears, such as her grandfather, who unapologetically worked with a trowel in one hand and the Bible in the other.

The once common practice of using the Bible as



Until the 1993 discovery of a ninth-century B.C. stela inscribed with "House of David," there was no nonbiblical evidence that David actually existed. Few dispute it now.

an archaeological guide has been widely contested as an unscientific case of circular reasoning—and with particular relish by Tel Aviv University's contrarian-in-residence Israel Finkelstein, who has made a career out of merrily demolishing such assumptions. He and other proponents of "low chronology" say that the weight of archaeological evidence in and around Israel suggests that the dates posited by biblical scholars are a century off. The "Solomonic" buildings excavated by biblical archaeologists over the past several decades at Hazor, Gezer, and Megiddo were not constructed in David and Solomon's time, he says, and so must have been built by kings of the ninth-century B.C.'s Omride dynasty, well after David and Solomon's reign.

During David's time, as Finkelstein casts it, Jerusalem was little more than a "hill-country village," David himself a raggedy upstart akin to Pancho Villa, and his legion of followers more like "500 people with sticks in their hands shouting and cursing and spitting—not the stuff of

Robert Draper wrote about the Aztec for last month's issue. Greg Girard is a Shanghai-based photographer who documents architectural and social change.

BIBLE QUEST

The golden age of a unified Israel lasted 80 years, from David's rise to king around 1010 B.C. to the death of his son Solomon in 930 B.C. At least, that's what the biblical chronology says. Archaeologists have found structures from the era, but neither carbon dating nor pottery evidence confirms exact dates, leaving the grandness of David and Solomon's empires open to interpretation.

FORTIFIED CITIES

- The Bible says Solomon "built everything he desired," including the cities of Hazor, Megiddo, and Gezer.
- ✓ By 1960 archaeologist Yigael Yadin had identified six-chambered gates at all three sites and proclaimed them built by Solomon.
- ⊗ Israel Finkelstein argued in 1996 that evidence suggests the gates were likely built by a different ruler a century later. The debate continues.

Key

- Biblical history
- ✓ Archaeological interpretation supporting biblical history
- ⊗ Archaeological interpretation contrary to biblical history

HOUSE OF DAVID

- Most Judaeen kings traced their lineage to David; Jewish prophets said the Messiah would be a descendant of David.
- ✓ A stela appearing to be inscribed with the words "House of David" was found at Tel Dan in 1993.
- ⊗ The inscription was made a century after Solomon's rule; a few argue it may not refer to the biblical David.

CITY OF DAVID

- When David became king, the Bible says, he commissioned a palace in Jerusalem at the site of the Fortress of Zion.
- ✓ In 2005 Eilat Mazar uncovered a monumental building in Jerusalem and identified it as David's palace, based on its location and pottery.
- ⊗ The date of construction is contested; the style of pottery was used over a long period.

CITY OF TWO GATES

- The Bible cites a Judaeen border town named Shaaraim, or "city of two gates," near the Elah Valley, where David battled Goliath.
- ✓ Yosef Garfinkel is excavating ruins there and has found olive pits and pottery he dates to David's time. Finding two gates, he announced he had found Shaaraim.
- ⊗ With only 5 percent of the site excavated, some remain skeptical.

ANCIENT COPPER MINES

- Solomon's temple, as described in the Bible, was filled with bronze objects that would have required extensive mines.
- ✓ Thomas Levy is excavating a large copper-production site dating to the tenth and ninth centuries B.C., which implies a complex, centralized society existed in Solomon's time.
- ⊗ Critics say the mines don't prove the existence of an Israelite kingdom.



DESPITE DECADES OF SEARCHING, ARCHAEOLOGISTS
HAD FOUND NO SOLID EVIDENCE THAT
DAVID OR SOLOMON EVER BUILT ANYTHING.

great armies of chariots described in the text.

“Of *course* we’re not looking at the palace of David!” Finkelstein roars at the very mention of Mazar’s discovery. “I mean, come on. I respect her efforts. I like her—very nice lady. But this interpretation is—how to say it?—a bit naive.”

Now it is Finkelstein’s theory that is under siege. On the heels of Mazar’s claim to have discovered King David’s palace, two other archaeologists have unveiled remarkable finds. Twenty miles southwest of Jerusalem in the Elah Valley—the very spot where the Bible says the young shepherd David slew Goliath—Hebrew University professor Yosef Garfinkel claims to have unearthed the first corner of a Judaeon city dating to the exact time that David reigned. Meanwhile, 30 miles south of the Dead Sea in Jordan, a University of California, San Diego professor named Thomas Levy has spent the past eight years excavating a vast copper-smelting operation at Khirbat en Nahas. Levy dates one of the biggest periods of copper production at the site to the tenth century B.C.—which, according to the biblical narrative, is when David’s antagonists the Edomites dwelled in this region. (However, scholars like Finkelstein maintain that Edom did not emerge until two centuries later.) The very existence of a large mining and smelting operation fully two centuries before Finkelstein’s camp maintains the Edomites emerged would imply complex economic activity at the exact time that David and Solomon reigned. “It’s *possible* that this belonged to David and Solomon,” Levy says of his discovery. “I mean, the scale of metal production here is that of an ancient state or kingdom.”

Levy and Garfinkel—both of whom have been awarded grants by the National Geographic Society—support their contentions with a host of scientific data, including pottery remnants and radiocarbon dating of olive and date pits

found at the sites. If the evidence from their ongoing excavations holds up, yesteryear’s scholars who touted the Bible as a factually accurate account of the David and Solomon story may be vindicated.

As Eilat Mazar says with palpable satisfaction, “This is the end of Finkelstein’s school.”

A BUSY HIGHWAY, Route 38, crosses the ancient road that follows the Elah Valley en route to the Mediterranean Sea. Beneath the hills on either side of the road lie the ruins of Socoh and Azekah. According to the Bible, the Philistines encamped in this valley, between the two towns, just before their fateful encounter with David.

The battlefield of legend is now quiet and abounds with wheat, barley, almond trees, and grapevines, not to mention a few of the indigenous terebinth (*elah* in Hebrew) trees from which the valley derives its name. A small bridge extends from Route 38 over the Brook of Elah. During high season, tourist buses park here so that their passengers can climb down into the valley and retrieve a rock to take back home and impress friends with a stone from the same place as the one that killed Goliath.

“Maybe Goliath never existed,” says Garfinkel as he drives across the bridge and up to his site, Khirbet Qeiyafa. “The story is that Goliath came from a giant city, and in the telling of it over the centuries, he became a giant himself. It’s a metaphor. Modern scholars want the Bible to be like the *Oxford Encyclopedia*. People didn’t write history 3,000 years ago like this. In the evening by the fire, this is where stories like David and Goliath started.”

Beneath Garfinkel’s bald, scholarly exterior and gentle sense of humor—which reveals a jagged edge when the subject is Israel Finkelstein—lurks a man of unmistakable ambition. He first





In the Elah Valley, where the Bible says David slew Goliath, excavations at the fortified city Khirbet Qeiyafa in 2008 unearthed a multichambered gate and artifacts dating to David's time, around 1000 B.C.

MANY EXCAVATIONS TAKE PLACE IN EASTERN
JERUSALEM, WHERE PALESTINIANS STAND TO BE DISPLACED IF
SUCH PROJECTS MORPH INTO ISRAELI SETTLEMENT CLAIMS.

learned from an Israeli Antiquities Authority ranger about a nine-foot-high megalithic wall looming over the Brook of Elah. He began digging in earnest in 2008.

The wall, Garfinkel discovered, was of the same variety seen in the northern cities of Hazor and Gezer—a casemate of two walls with a chamber in between—and it encircled a fortified city of about six acres. Private houses abutted the city wall, an arrangement not seen in Philistine society. After shoveling out the topsoil, Garfinkel uncovered coins and other artifacts from the time of Alexander the Great. Beneath that Hellenistic layer he found buildings scattered with four olive pits, which carbon-14 analysis dated to around 1000 B.C. He also found an ancient tray for baking pita bread, along with hundreds of bones from cattle, goats, sheep, and fish—but no pig bones. In other words, Judaeans, rather than Philistines, must have lived (or at least dined) here. Because Garfinkel's excavation team also uncovered a very rare find—a clay pottery sherd with writing that appears to be a proto-Canaanite script with verbs characteristic of Hebrew—the conclusion to him seemed obvious: Here was a tenth-century B.C. complex Judaeon society of the sort that low chronologists like Finkelstein claimed did not exist.

And what was its name? Garfinkel found his answer upon discovering that the fortified city had not one but two gates—the only such site found thus far in the kingdoms of Judah and Israel. “Two gates” translates into Hebrew as *shaarayim*, a city mentioned three times in the Bible. One of those references (I Samuel 17:52) describes the Philistines fleeing David back to Gath via the “road from Shaaraim.”

“You have David and Goliath, and you have our site, and it fits,” says Garfinkel simply. “It’s

typical Judaea, from the animal bones to the city wall. Give us two arguments why this is Philistine. One argument is because Finkelstein doesn’t want us to destroy low chronology. OK, so give us a second reason.”

Here would be a second reason to be skeptical of Yossi Garfinkel's conclusions: He announced them, swiftly and dramatically, despite the fact that he had only four olive pits on which to base his dating, a single inscription of a highly ambiguous nature, and a mere 5 percent of his site excavated. In other words, says archaeologist David Ilan, “Yossi has an agenda—partly ideological, but also personal. He’s a very smart and ambitious guy. Finkelstein’s the big gorilla, and the young bucks think he’s got a monopoly over biblical archaeology. So they want to dethrone him.”

Better still, from the perspective of other interested parties: Once Finkelstein retreats from the throne, King David returns to it.

HE HAS PERSISTED FOR THREE MILLENNIA—an omnipresence in art, folklore, churches, and census rolls. To Muslims, he is Daoud, the venerated emperor and servant of Allah. To Christians, he is the natural and spiritual ancestor of Jesus, who thereby inherits David's messianic mantle. To the Jews, he is the father of Israel—the shepherd king anointed by God—and they in turn are his descendants and God's Chosen People. That he might be something lesser, or a myth altogether, is to many unthinkable.

“Our claim to being one of the senior nations in the world, to being a real player in civilization's realm of ideas, is that we wrote this book of books, the Bible,” says Daniel Polisar, president of the Shalem Center, the Israeli research institute that helped fund Eilat Mazar's excavation work. “You take David and his kingdom out of

the book, and you have a different book. The narrative is no longer a historical work, but a work of fiction. And then the rest of the Bible is just a propagandistic effort to create something that never was. And if you can't find the evidence for it, then it probably didn't happen. That's why the stakes are so high."

The books of the Old Testament outlining the story of David and Solomon consist of scriptures probably written at least 300 years after the fact, by not-so-objective authors. No contemporaneous texts exist to validate their claims. Since the dawn of biblical archaeology, scholars have sought in vain to verify that there really was an Abraham, a Moses, an Exodus, a conquest of Jericho. At the same time, says Amihai Mazar, Eilat's cousin and among Israel's most highly regarded archaeologists, "Almost everyone agrees that the Bible is an ancient text relating to the history of this country during the Iron Age. You can look at it critically, as many scholars do. But you can't ignore the text—you must relate to it."

But, adds Mazar, "you shouldn't seek to prove the text verbatim." And yet multitudes of archaeologists have made that very goal their life's work, beginning with the American scholar and godfather of biblical archaeology William Albright. Among Albright's protégés was the Israeli military titan, politician, and scholar Yigael Yadin. For Yadin and his contemporaries, the Bible was unassailable. As a result, when he uncovered the city gates at the biblical city of Hazor in the late 1950s, Yadin committed what would be a current-day archaeological no-no: Since carbon dating wasn't available, he used the Bible, along with the stratigraphy, to date the pottery found inside the gates. He attributed the gates to the exalted tenth-century B.C. empire of Solomon—because the First Book of Kings said so.

The problem with relying on this particular chapter of the Bible is that it was added long after Solomon died in 930 B.C., when Israel had split into two parts—Judah in the south and Israel in the north. "Gezer was the most southerly city



A painting depicts Solomon's wisdom: When two women claim a baby, he orders it divided by a sword; the woman willing to give up the baby is its mother.

in the northern kingdom of Israel, while Hazor was in the most northern realm, and Megiddo was an economic hub in the center," says Tel Aviv University archaeologist Norma Franklin. "So it would be important to the people writing this story to lay claim to all of this territory. To Yadin, the Bible said so and that was it. Three gates—they all have to be Solomon's."

Today, many scholars (including Franklin and her colleague Finkelstein) doubt that all three gates are Solomonic, while others (Amihai Mazar, for example) think they could be. But all of them reject Yadin's circular reasoning, which in the early 1980s helped spawn a backlash movement of "biblical minimalism," led by scholars at the University of Copenhagen. To the minimalists, David and Solomon were simply fictitious characters. The credibility of that position was undercut in 1993, when an excavation team in the northern Israel site of Tel Dan dug up a black basalt stela inscribed with the phrase "House of David." Solomon's

NOVA | **NATIONAL GEOGRAPHIC**

Quest for Solomon's Mines A new NOVA–National Geographic Special airs Tuesday, November 23, on PBS; check local listings.



The City of David is both the oldest neighborhood in Jerusalem and an archaeological dig south of the Temple Mount. Traditionally believed to be the site of King David's palace, it is a major tourist draw despite a paucity of evidence that he built there.





Archaeology students examine Khirbat en Nahas, an ancient copper-smelting center south of the Dead Sea. According to carbon analysis, the site dates to the tenth century B.C., suggesting it could be the famed mines of King Solomon.



existence, however, remains wholly unverified.

Absent more evidence, we're left with the decidedly drab tenth-century B.C. biblical world that Finkelstein first proposed in a 1996 paper—not a single great kingdom replete with monumental buildings but instead a scruffy landscape of disparate, slowly gelling powers: the Philistines to the south, Moabites to the east, Israelites to the north, Aramaeans farther north, and yes, perhaps, a Judaeen insurgency led by a young shepherd in not-so-dazzling Jerusalem. Such an interpretation galls Israelis who regard David's capital as their bedrock. Many of the excavations undertaken in Jerusalem are financially backed by the City of David Foundation, whose director of international development, Doron Spielman, freely admits, "When we raise money for a dig, what inspires us is to uncover the Bible—and that's indelibly linked with sovereignty in Israel."

Unsurprisingly, this agenda does not sit well with the Jerusalem residents who happen to be Palestinian. Many excavations take place in the eastern part of the city, where their families have dwelled for generations but stand to be displaced if such projects morph into Israeli settlement claims. From the Palestinian perspective, the scurrying for archaeological evidence to justify a people's sense of belonging misses the point. As East Jerusalem resident and archaeology professor Hani Nur el-Din says, "When I see Palestinian women making the traditional pottery from the early Bronze Age, when I smell the *taboon* bread baked in the same tradition as the fourth or fifth millennium B.C., this is the cultural DNA. In Palestine there's no written document, no historicity—but still, it's history."

Most Israeli archaeologists would prefer that their work not be used as a political wedge. This, nonetheless, is the way of young nations. As Bar-Ilan University archaeology professor Avraham Faust observes, "The Norwegians relied on Viking sites to create a separate identity from their Swedish and Danish rulers. Zimbabwe is named after an archaeological site. Archaeology is a very convenient tool for creating national identities."

That is one way in which Israel differs from other

DOES DAVID, WITH ALL HIS METAPHORICAL POWER,
CEASE TO MATTER IF HIS DEEDS AND HIS EMPIRE ARE
ULTIMATELY VIEWED AS WORKS OF FICTION?

countries. Its national identity came well before any digging. What's dug up can only confirm that identity...or not.

"THIS PLACE WAS HELL," says Tom Levy cheerfully as he stands over an open pit filled with ancient coal-black slag. Sprawling around him and his volunteer undergraduates from the University of California, San Diego is a 25-acre copper production site—and adjacent to it, a large fortress complex that includes the ruins of 3,000-year-old guardhouses. Apparently the sentinels lived practically on top of the smelting operations, while overseeing a presumably reluctant labor force. "When you have industrial production of this scale, you have to have a procurement system for food and water," Levy continues. "I can't prove it, but I think that the only people that are going to be working in this rather miserable environment are either slaves—or undergrads. The point is, simple tribal societies couldn't do something like this."

Levy, an anthropologist, first came to southern Jordan in 1997 to examine metallurgy's role in social evolution. The lowland district of Faynan, where the blue-green glitter of malachite can be seen from a distance, was an obvious place to study. It also happened to be where the American rabbi and archaeologist Nelson Glueck unabashedly proclaimed in 1940 that he had discovered the Edomite mines controlled by King Solomon. Subsequent British excavators believed they had found evidence that Glueck was off by some three centuries and that Edom actually dated to the seventh century B.C. But when Levy started probing the site known as Khirbat en Nahas (Arabic for "ruins of copper"), the samples he sent off to Oxford for radiocarbon dating confirmed that Glueck had been on the right track: This was

a tenth-century copper-production site—and, Levy adds pointedly, "the closest copper source to Jerusalem."

The team headed by Levy and his Jordanian colleague Mohammad Najjar has uncovered a four-chambered gate similar to ones found at sites in Israel that might date to the tenth-century B.C. A few miles from the mines, they've excavated a cemetery of more than 3,500 tombs dating to the same period—perhaps filled with the remains of Iron Age mountain nomads known from ancient Egyptian sources as Shasu, who Levy thinks may have been "corralled at certain points in time and forced to work in the mines." Most work in the mines appears to have ceased by the end of the ninth century—and the so-called "disruption layer" uncovered by Levy's students may explain why.

They found in this layer 22 date pits, which they dated to the tenth century B.C., along with Egyptian artifacts such as a lion-headed amulet and a scarab, both from the time of the pharaoh Shoshenq I. That ruler's invasion of the region shortly after Solomon's death is chronicled in the Old Testament and at the Temple of Amun at Karnak. "I definitely believe that Shoshenq disrupted metal production here at the end of the tenth century," says Levy. "The Egyptians in the Third Intermediate Period weren't strong enough to field an occupying force, which is why you don't see Egyptian bread molds and other material culture here. But they could organize some pretty big military campaigns—strong enough to upset these petty kingdoms, to make sure they wouldn't be a threat to them. That's what I think Shoshenq did here."

The "hell" that Levy has unearthed at Khirbat en Nahas could prove to be hell for the Finkelstein school of low chronology. Levy's copper mines may not be as sexy as King David's

palace or the perch overlooking the battle of David and Goliath. But Levy's excavation work spans more time and area than those of Eilat Mazar and Yosef Garfinkel, with far more extensive use of radiocarbon analysis to determine the age of his site's stratigraphic layers. "All scholars dealing with Edom in the last two generations claimed that Edom didn't exist as a state before the eighth century B.C.," says Amihai Mazar. "But Levy's radiocarbon dates have their own story, and that story is related to the tenth to ninth century B.C., and no one can claim that they're incorrect."

In fact, that is precisely what Levy's critics are doing. Some deemed his first 46 datings insufficient to justify reordering an entire chronology for Edom. For his second round of C-14 analysis, Levy doubled the number of samples and meticulously selected charcoal from shrubs with verifiable outer growth rings.

Despite the high cost of C-14 analysis—more than \$500 for a single olive pit—the technique isn't a silver bullet. "Carbon-14 doesn't help you solve all this controversy," says Eilat Mazar. "You have the plus or minus"—a margin of error of about 40 years. "You have different laboratories bringing different interpretations. You have debates about the whole C-14 issue." Indeed, Finkelstein and Amihai Mazar have been locked in an ongoing tussle over the dating of a single stratum at Tel Rehov, a Bronze and Iron Age city just west of the Jordan River. Mazar contends that the stratum could be Solomonic. Finkelstein says it's from the later Omride dynasty, named for Omri, Ahab's father. The gap between the two eras is about 40 years.

"Many of the radiocarbon dates for this period cover exactly the range that's under debate," Amihai Mazar says, chuckling wearily. "Not before and not after. It's been this way for 15 years."

"YOU CAN FIND EVIDENCE in radiocarbon for David being a villager in Norway in the sixth century A.D.!" declares Israel Finkelstein—exaggerating to make a point, as he is prone to doing. "But look, I enjoy reading everything Tom writes about Khirbat en Nahas. It


has brought all sorts of ideas to me. I myself would never dig in such a place—too hot! For me, archaeology is about having a good time. You should come to Megiddo—we live in an air-conditioned B&B next to a nice swimming pool."

This is how Finkelstein begins his rebuttals, with amiable preambles that cannot conceal the Mephisto-like gleam in his eyes. For a scholar, the Tel Aviv archaeologist has a highly visceral manner—leaning his tall, bearded frame into a visitor's face, waving his large hands, modulating his baritone with Shakespearean agility.

Yet his charm wears thin for those who have felt the sting of his attacks. "If you want to attract attention, you behave like Finkelstein," says Eilat Mazar. Similarly unamused is Yosef Garfinkel, who says of Finkelstein's recent receipt of a four-million-dollar research grant, "He doesn't even use science—that's the irony. It's like giving Saddam Hussein the Nobel Peace Prize."

Still, Finkelstein's theories strike an intellectually appealing middle ground between biblical literalists and minimalists. "Think of the Bible the way you would a stratified archaeological site," he says. "Some of it was written in the eighth century B.C., some the seventh, and then going all the way to the second B.C. So 600 years of compilation. This doesn't mean that the story doesn't come from antiquity. But the reality presented in the story is a later reality. David, for example, is a historical figure. He did live in the tenth century B.C. I accept the descriptions of David as some sort of leader of an upheaval group, troublemakers who lived on the margins of society. But not the golden city of Jerusalem, not the description of a great empire in the time of Solomon. When the authors of the text describe that, they have in their eyes the reality of their own time, the Assyrian Empire.

"Now, Solomon," he continues with a sigh. "I think I destroyed Solomon, so to speak. Sorry for that! But take Solomon, dissect it. Take the great visit of the Queen of Sheba—an Arabian

 **Society Grant** The archaeological work of Yosef Garfinkel and Thomas Levy is funded in part by your National Geographic Society membership.



Ethiopian Jews, also known as Beta Israel, celebrate a festival in Jerusalem. They believe themselves descendants of King Solomon and the Queen of Sheba. Most escaped famine and political turmoil when they were airlifted to Israel in the 1980s and '90s.



queen coming to visit, bringing all sorts of exotic commodities to Jerusalem. This is a story which is an impossibility to think about before 732 B.C., before the beginning of Arabian trade under Assyrian domination. Take the story of Solomon as the great, you know, trainer in horses and chariots and big armies and so on. The world behind Solomon is the world of the Assyrian century.”

Of Levy’s mining fortress, Finkelstein says, “I don’t buy that it’s from the tenth century B.C. There’s no way people lived on this site during production. The fire, the toxic fumes—forget it! Instead, look at the fortress of En Hazeva on our side of the Jordan River, built by the Assyrians on the main road to Edom. I see Tom’s building as an eighth-century Assyrian fortress parallel to the other one. And look, at the end of the day, his is a marginal site. It’s not a stratified city with many eras, like Megiddo and Tel Rehov. Taking ■ pile of slag and making it the center of the discussion of biblical history—forget it, no way, I reject this absolutely!”

With greater venom, Finkelstein mocks Garfinkel’s discoveries at Khirbet Qeiyafa: “Look, you’ll never catch me saying, ‘I’ve found one olive pit at a stratum in Megiddo, and this olive pit—which goes against hundreds of carbon-14 determinations—is going to decide the fate of Western civilization.’” He snickers. The lack of pig bones, suggesting it is a Judaeon site? “A gun, but not a smoking gun.” The rare inscription found at the site? Probably from Philistine Gath rather than the kingdom of Judah.

The irony is that biblical archaeology’s enfant terrible has become the establishment, a Goliath fending off upstart assaults on his chronological order. The proposition that a complex tenth-century B.C. society may have existed on either side of the Jordan River has thrown Finkelstein’s vision of the David and Solomon era squarely on the defensive. His many rebuttal papers and his sarcastic tone reflect that defensiveness, and his arguments at times seem a bit desperate. (The notion of living in a fortress next to ■ copper-smelting site would not seem ludicrous to West Virginia coal miners or



The Western Wall in Jerusalem is a favored venue for Jewish wedding photos and bar mitzvah celebrations. It is all that remains of the vast temple complex built by King Herod late in the first century B.C., allegedly over the ruins of King Solomon's temple.



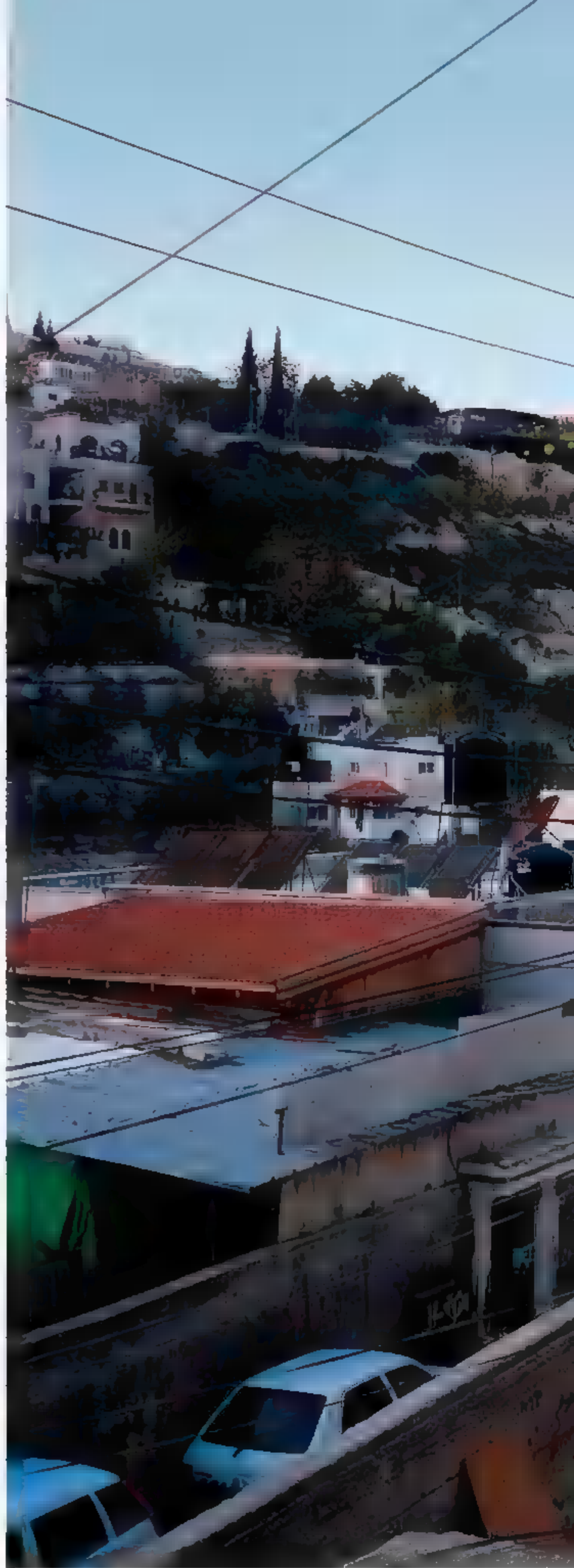
residents near Three Mile Island, for example.)

Still, even if Garfinkel can prove that the Judah tribe that begat David dwelled in the fortress of Shaaraim, and Eilat Mazar can document that King David commissioned a palace in Jerusalem, and Tom Levy can successfully demonstrate that King Solomon oversaw copper mines in Edom, this does not a glorious biblical dynasty make. How much digging before the argument is settled?

MANY ARCHAEOLOGISTS question whether the obsessive scramble to prove the biblical narrative is a healthy enterprise. One of them, Tel Aviv University's Raphael Greenberg, flatly states, "It's bad for archaeology. What we're supposed to contribute is a point of view that isn't available from texts or preconceived notions of history—an alternative vision of the past: relations between rich and poor, between men and women. Something richer, in other words, than just validating the Bible."

But does David, with all of his metaphorical power, cease to matter if his deeds and his empire are ultimately viewed as works of fiction? When I point out to Finkelstein that people all over the world are invested in the greatness of David, I am surprised by his response. "Look, when I'm doing research, I *have* to distinguish between the culture of David and the historical David. David is extremely important for my cultural identity. In the same way, I can celebrate the Exodus without seeing it as a purely historic event. David for me is the David reflected in the later king Hezekiah, the David reflected in the later king Josiah, the David of Zacharias in the eschatological prophecies in which Jerusalem is burned but David is alive, the David who is the connection with the beginning of Christianity. In this sense, David is *everything*. If you want me to say it simplistically, I'm proud that this nobody from nowhere became the center of Western tradition.

"So for me," says Finkelstein, David's de-throner, "David is not a plaque on the wall, not even merely a leader of a tenth-century band. No. Much more than that." □





Mansour Yousef al-Shyoukhi practices the risky art of fire-breathing—a homegrown hobby—on the back porch of his residence in Silwan, a neighborhood near the Temple Mount. Palestinians here go about their daily lives despite fears that further excavations might displace them from their homes.

STAR STRUCK

Astronomers turn their telescopes to the unbounded beauty of the Milky Way.



Veiled by cosmic dust, the Milky Way arches over Haleakala Crater on Maui.
WALLY PACHOLKA (PANORAMA COMPOSED OF THREE SIDE-BY-SIDE PHOTOGRAPHS)



It's hard to be modest when you live in the Milky Way.

Our galaxy is far larger, brighter, and more massive than most other galaxies. From end to end, the Milky Way's starry disk, observable with the naked eye and through optical telescopes, spans 120,000 light-years. Encircling it is another disk, composed mostly of hydrogen gas, detectable by radio telescopes. And engulfing all that our telescopes can see is an enormous halo of dark matter that they can't. While it emits no light, this dark matter far outweighs the Milky Way's hundreds of billions of stars, giving the galaxy a total mass one to two trillion times that of the sun. Indeed, our galaxy is so huge that dozens of lesser galaxies scamper about it, like moons orbiting a giant planet.

As a result of its vast size, the Milky Way can boast at least one planet with intelligent life. Giant galaxies like the Milky Way and the nearby, even larger Andromeda galaxy possess the

power to create and retain a rich supply of iron, oxygen, silicon, magnesium, and other elements heavier than helium. Forged by the Milky Way's abundant stars, such heavy elements are the building blocks of terrestrial planets.

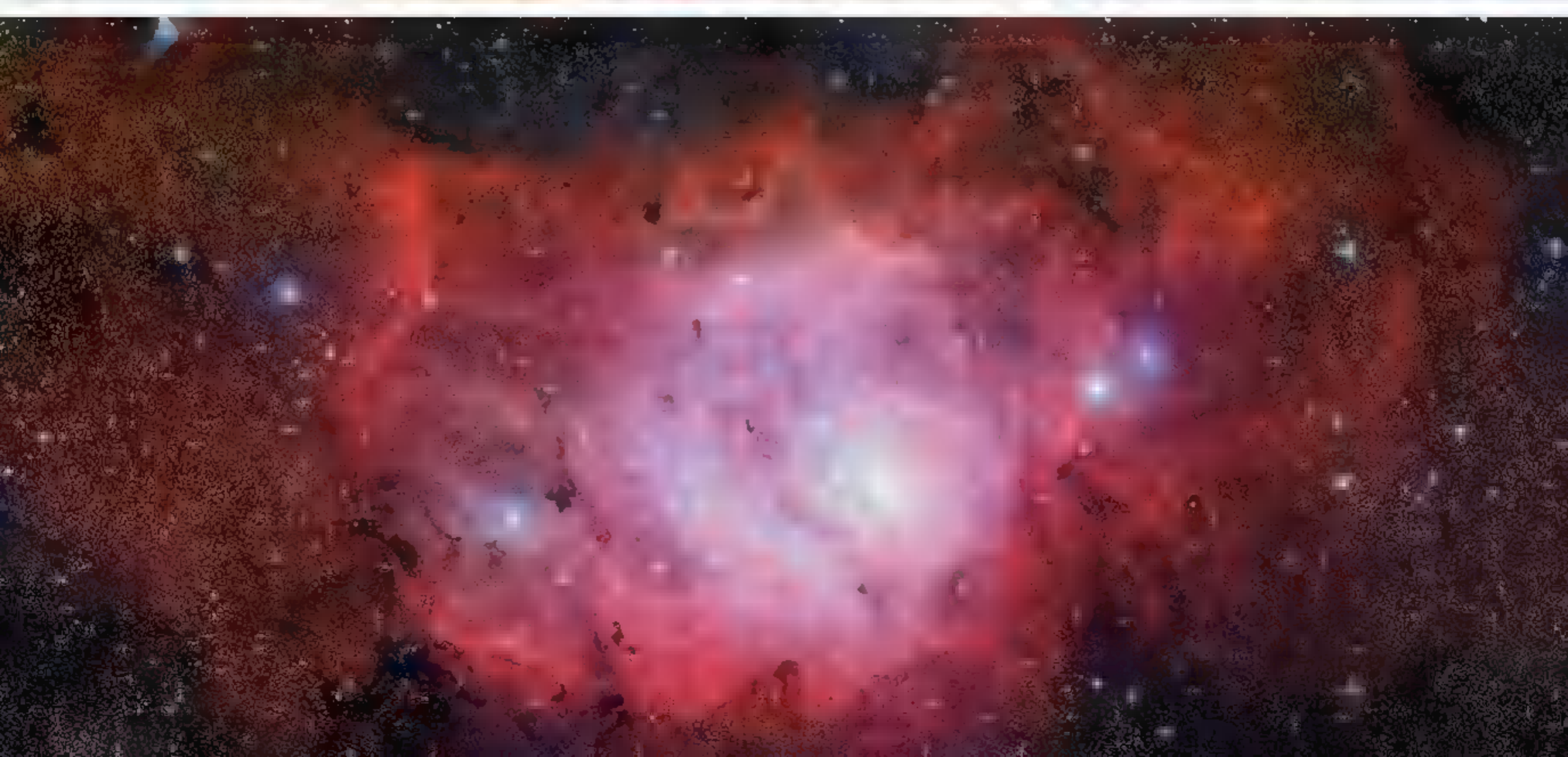
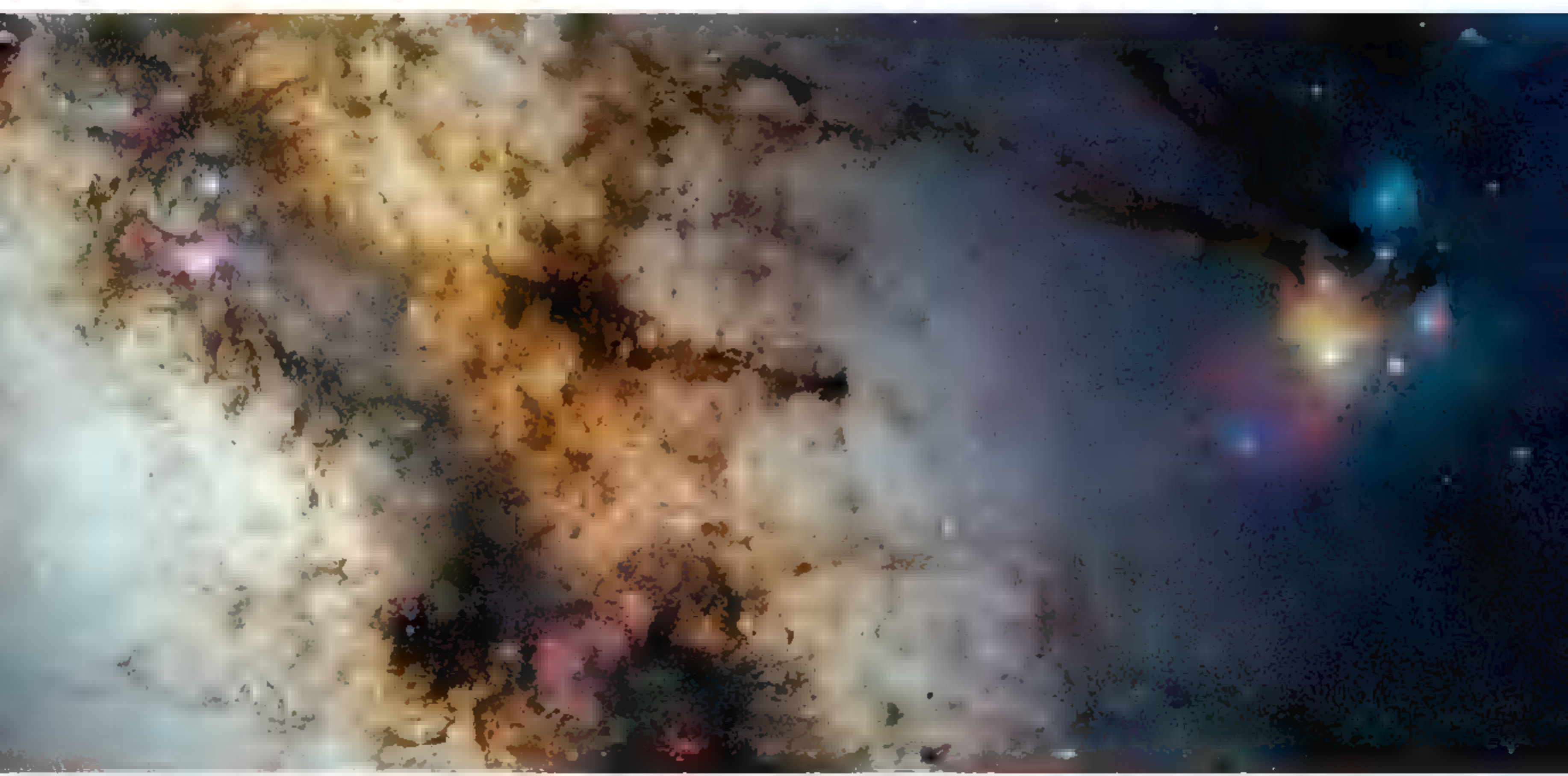
Heavy elements are equally essential for life: Witness the oxygen we breathe, the calcium in our bones, the iron in our blood. When a star explodes in a lesser galaxy, this raw material for life shoots out into space at millions of miles an hour and is lost. But in the Milky Way, the elements encounter interstellar gas and dust and are restrained by the strength of the galaxy's immense gravitational field. These impediments slow their speed, so they can enrich star-forming gas clouds with the ingredients for new generations of stars and planets. That's what happened 4.6 billion years ago, when the sun and the Earth emerged from a now-vanished interstellar nebula.

Because we reside within the Milky Way, we actually know less about its overall appearance than we do about distant galaxies—just as absent a mirror, you know more about your friends' faces than your own. Nevertheless, in the past decade astronomers have made numerous new discoveries about our galaxy, beginning with revelations about the huge black hole at its heart.

Every star in the Milky Way revolves around this black hole, named Sagittarius A* (abbreviated "Sgr A*" and pronounced "Sagittarius A-star"). The sun, 27,000 light-years away, completes a revolution once every 230 million years. Within just a light-year of the black hole swarm more than 100,000 other stars caught far more firmly in its grip. Some take only a few years to complete their orbits. These paths reveal that Sgr A* is four million times the mass of the sun,

The Milky Way, in an artist's conception above, unfolds in increasing detail through images from the European Southern Observatory's GigaGalaxy Zoom project. Top: A panoramic mosaic of the galaxy edge-on covers the entire celestial sphere. Middle: Through an amateur telescope, dust obscures the galaxy's center, while the colorful Antares and Rho Ophiuchi regions shine at right. Bottom: The 2.2-meter telescope at La Silla Observatory in Chile focuses on the Lagoon Nebula, 100 light-years across.

ROBERT HURT, NASA/JPL (ABOVE); SERGE BRUNIER, ESO (TOP RIGHT); STÉPHANE GUISSARD, ESO (MIDDLE AND BOTTOM RIGHT)

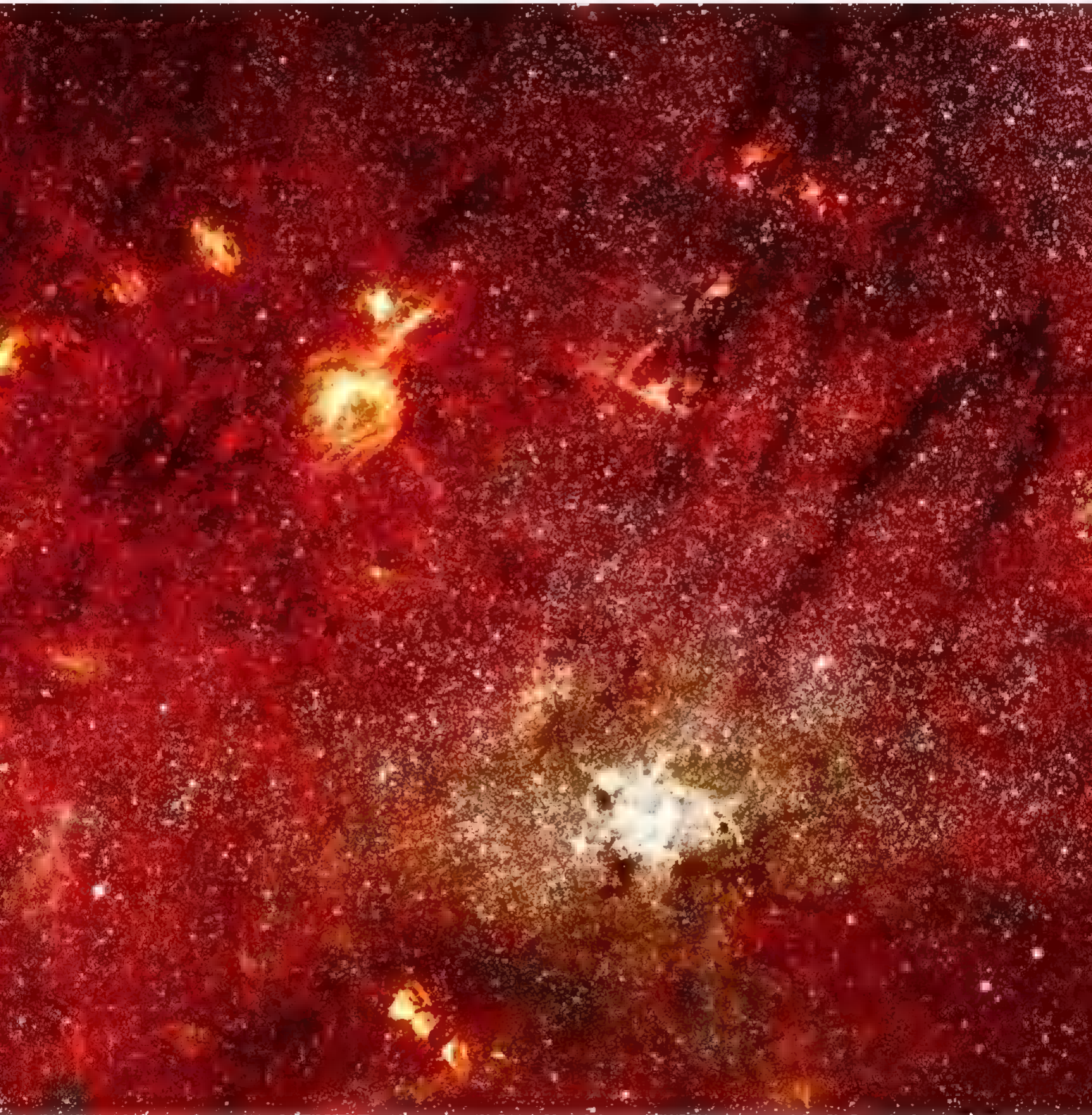


**DESPITE THE VIOLENCE AROUND THE BLACK HOLE,
THE GALACTIC CORE IS A FERTILE PLACE.**



An infrared portrait of the galactic core, a composite from the Hubble and Spitzer space telescopes, reveals bright star clusters and hundreds of thousands of massive stars amid dust and swirls of hot ionized gas. The galaxy's black hole lurks within the luminous Central cluster at right.

NASA/ESA/JPL/DANIEL WANG, UNIVERSITY OF MASSACHUSETTS, AMHERST, AND SUSAN STOLOVY, SPITZER SCIENCE CENTER, CALTECH





NASA's Chandra X-ray Observatory captures Sagittarius A*, the galaxy's supermassive black hole. Red lobes of 40-million-degree gas linger from violent eruptions in the past, when the black hole was consuming matter more voraciously than it is now.

somewhat more massive than had been thought a decade ago.

Every now and then, the black hole swallows a bit of gas, a wayward planet, or even an entire star. Friction and gravity heat the victim to such high temperatures that it lets out a scream of x-rays. These light up nearby gas clouds, preserving a record of the black hole's past feasts. For example, in 2004 scientists reported an x-ray echo in a gas cloud some 350 light-years from the black hole. Since x-rays travel at the speed of light, the echo

indicates that an object fell into the black hole around 350 years ago. The x-ray intensity suggests it had the mass of a small planet. Another object took the plunge as recently as the 1940s.

Surprisingly, the black hole also catapults stars away. In 2005 astronomers reported an extraordinarily fast-moving star some 200,000 light-years from the galactic center. "It was serendipitous," says Warren Brown at the Harvard-Smithsonian Center for Astrophysics. He was searching for "star streams"—remnants of small

EVERY NOW AND THEN, THE BLACK HOLE SWALLOWS A BIT OF GAS, A WAYWARD PLANET, OR EVEN AN ENTIRE STAR.

galaxies the Milky Way's gravitational pull has torn to shreds—when he found a star in the constellation Hydra racing away from the galactic center at 709 kilometers a second, or 1.6 million miles an hour. At that speed, it will escape the galaxy's grasp and sail off into intergalactic space. By 2010 Brown and other astronomers had discovered 15 more of these hypervelocity stars.

In a remarkable display of prescience, Jack Hills, while at the Los Alamos National Laboratory in New Mexico, had predicted just such a phenomenon. "I was actually rather surprised that the discovery had taken so long," says Hills, "but I was certainly delighted." In a 1988 paper, Hills wrote that if a binary star—two stars orbiting each other—ventured too close to Sgr A*, one star of the pair could fall toward the black hole and go into a tighter orbit around it, thereby losing an enormous amount of energy. Since the laws of physics dictate that energy be conserved, the other star would gain an equally large energy boost, flying away at tremendous speed. Over the Milky Way's lifetime, says Brown, the black hole may have flung a million stars out of the galaxy in this fashion.

Despite the violence around the black hole, the galactic core is a fertile place. Stars congregate most tightly at the galaxy's center, so the life-giving heavy elements they create are most plentiful there. Even near our sun—a bright yellow star halfway between the black hole and the edge of the starry disk—many newborn stars possess orbiting disks of gas and dust that survive millions of years, long enough to give birth to planets.

In contrast, prospects for planets at the galaxy's edge are bleak. Last year Chikako Yasui, now at the National Astronomical Observatory of Japan, and her colleagues reported on 111 newborn stars in a Milky Way exurb, over twice as far out as the sun. These youngsters had low supplies of heavy elements—for example, their oxygen content was only 20 percent of the sun's. Although the stars were just half a million years old—still in their infancy in stellar time scales—most had already lost their planet-forming disks of gas and dust. No disks, no planets; and no planets, no life. Quipped science writer Ian

O'Neill on his astronomy blog *Astroengine*, "Life is grim on the galactic rim."

Stars with even lower amounts of oxygen and iron offer insight into the birth of the galaxy itself. Residing in the stellar halo extending above and below the galaxy's disk, these stars are so old that they formed before earlier generations of stars had much of a chance to produce heavy elements. Thus, the typical halo star has only 3 percent of the sun's iron content.

Astronomers traditionally date the stellar halo, and hence the age of the entire galaxy, by studying globular clusters—bright, tightly packed conglomerations of stars so old that their shorter lived stars have died. But estimates of their ages depend on theories of how stars live and perish.


Fortunately, there is another way to measure the galaxy's age. While still a graduate student at the Australian National University, Anna Frebel began looking for individual stars in the halo. "I want to find these stars because I want to look back in time," says Frebel, now at the Harvard-Smithsonian Center for Astrophysics. In 2005 she discovered a halo star in the constellation Libra with just 1/1000 of the sun's iron content—low, even by halo standards, indicating it is so pristine it probably arose from gas enriched by a single supernova. Unlike most supernovae, this one spewed lots of elements far heavier than iron, including radioactive thorium and uranium.

For Frebel, this was a lucky star indeed. Since these radioactive elements decay at a steady rate, comparing their abundance in the star today allowed her to estimate its age: around 13.2 billion years old. Although that figure is uncertain by two or three billion years, it agrees with the ages derived from studies of globular clusters, and it suggests that the Milky Way is only slightly younger than the universe itself, which is 13.7 billion years old. The mighty galaxy whose countless stars would later make life possible on Earth didn't waste any time being born. □

*Ken Croswell is the author of eight books on astronomy, including *Magnificent Universe*.*



Storm clouds gather over Nushagak Bay, where a tempest is raging over the proposed Pebble mine.



Alaska's Choice **SALMON** **OR GOLD**

If built, a huge mine would transform Alaska's Bristol Bay region, possibly jeopardizing the world's richest sockeye salmon fishery.



Relying on memory and a keen sense of smell, sockeye find their way from the ocean to their natal



stream near Iliamna Lake, downstream of the mine site. Their fry will spend a year or two in the lake.



“We love our fish!” says Ina Bouker, a Yupik native and teacher from Dillingham who opposes the



mine. "The salmon always run. But if their habitat is destroyed, they will not come back."

By Edwin Dobb

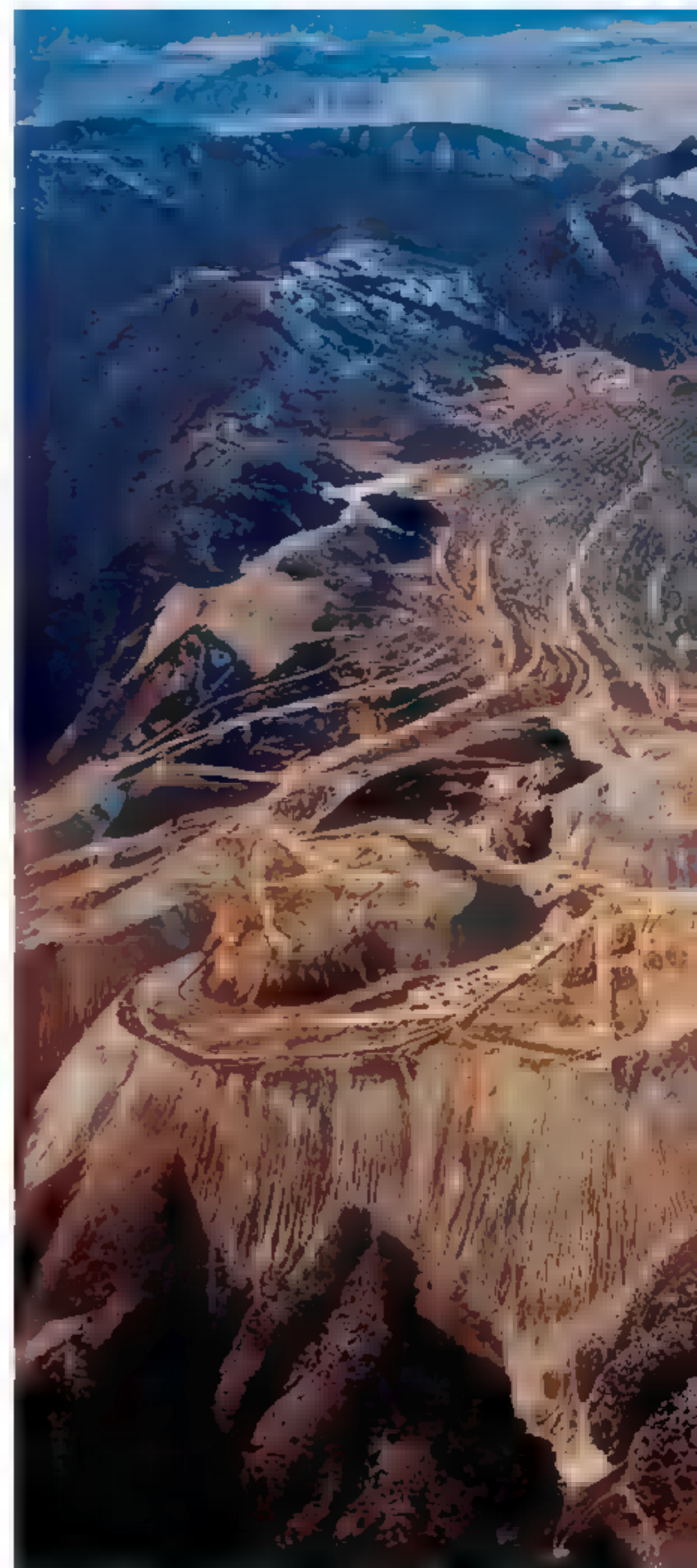
Photographs by Michael Melford

All that the American

West once was, Alaska still is. Abounding with natural marvels and largely untouched by human ambition, it strikes the newcomer as a land of endless prospect, an impression vividly reinforced from the passenger seat of a low-flying Cessna 180. Rick Halford, a bush pilot and former Republican state legislator, is showing me a piece of Alaska tucked between national parks and other protected lands about 250 miles southwest of Anchorage: the heart of the Bristol Bay watershed. Never was the term more meaningful. In every direction the dominant feature of the landscape, the element that binds everything together, is water. Within this 40,000-square-mile area are nine major rivers fed by dozens of tributaries that sometimes resemble stiff tree branches, sometimes sinuous arteries. Here are ponds so great in number and whimsical of shape they call to mind a crowded Joan Miró canvas stretching to the horizon. In more places than not, the water table lies near the surface, producing seeps and springs, continually recharging the spongelike tundra. This is a wet place indeed.

We fly upstream, following the Nushagak River toward its source, passing braided stretches where it is joined by the Wood, Iowithla, and Kokwok. Far to the right, the west end of Iliamna Lake, Alaska's largest, comes into view. Aside from a few scattered villages and the plane's fleeting shadow, no human signs are visible. No dams, no deforestation, no highways, housing divisions, or power plants. That this place is mostly undeveloped helps explain why it is home to the world's largest sockeye salmon runs and one of North America's largest chinook, or king, salmon runs, to say nothing of the trophy rainbow trout and grayling and other species that flourish here.

We near our destination, the locus of the toughest dilemma this uncommonly pristine and biologically productive region has ever faced. "Here it is," Halford says, "the spot where streams drain in three directions." From this hilly expanse north of Iliamna Lake, the Chulitna River



The 2.75-mile-wide pit in Utah's Bingham Canyon Mine (above) is visible even from space. With perhaps the world's largest deposit of gold and one of the largest of copper, the Pebble mine too would require a huge open pit—and fail-safe toxic-waste containment.

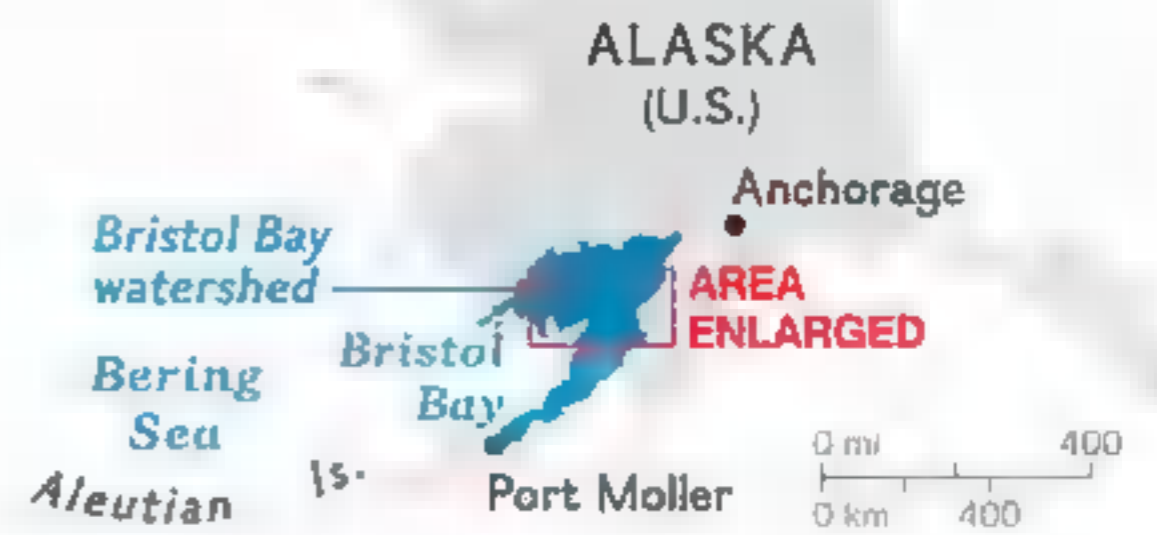


flows east into Lake Clark, heart of the Lake Clark National Park and Preserve. The South and North Forks of the Koktuli River meander northwest into the Mulchatna River, which feeds the Nushagak, and Upper Talarik Creek tumbles south into Iliamna Lake, which empties into the Kvichak River, which, like the Nushagak, eventually reaches Bristol Bay. Every summer, during a period lasting a few weeks, 30 to 40 million adult sockeye return to the bay. Driven by an ancient and unforgiving imperative, they swim against the shallow currents of these rivers up to their headwaters to spawn and die so that their kind may endure.

But salmon are not the only outstanding feature of this Alaska wilderness. Where the uppermost reaches of three streams originate, a geologic anomaly has been found—an ore body that may hold the world's largest deposit of gold and one of the largest of copper. Two companies, Northern Dynasty, of British Columbia, and Anglo American, a giant multinational based in England, have teamed up as the Pebble Partnership to evaluate the potential for an open-pit mine—possibly up to two miles wide and 1,700 feet deep—and an underground mine of similar scale. The prospect alarms many, especially those who depend on or value the

High-stakes Mine

In summer, millions of fish disperse up Bristol Bay's watershed to rivers and lakes that are breeding grounds for five species of salmon. If the Pebble mine is built, it will alter this wilderness and could, in time, wreak havoc with the salmon. Edmund Fogels, head of permitting in Alaska's Department of Natural Resources, says the mine will not be approved if there's "any chance of causing a collapse of the fisheries."



FINITE WEALTH

\$100-500 billion
Estimated total value of the Pebble mineral deposit



2,000
Estimated number of mine-construction jobs; operating jobs would employ 800-1,000


SUSTAINABLE WEALTH


\$120 million
Estimated annual value of the Bristol Bay salmon fishery

11,572
Estimated number of resident and nonresident workers in the fish harvesting and processing industry



 Rivers and streams important for fish that migrate from the sea upriver to spawn
 Downstream from proposed Pebble project

 Other rivers and streams

 Site of explored or potential mineral deposits

TOXIC TAILINGS Huge tailing ponds within the leased area would hold toxic by-products. Any leakage into waterways could harm the fishery.

WATER RESOURCES More than 30 billion gallons of water a year, used to sustain mine operations, could be drawn from the Kaktuli River and Upper Talarik Creek.

BROADER ACCESS An 86-mile expanded road and a pipeline would cross streams and could affect fish swimming to and from spawning areas.



VIRGINIA W. MASON, NGM STAFF
 SOURCES: USGS; ALASKA DEPARTMENT OF FISH AND GAME;
 ALASKA DEPARTMENT OF NATURAL RESOURCES; PEBBLE
 PARTNERSHIP (LEASING AND PEBBLE MINERAL-DEPOSIT DATA)

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The South Fork of the Kaktuli River—ideal habitat for coho salmon—flows near the Pebble site. Water



withdrawals for the mine could drain the stream's headwaters, leaving fingerlings high and dry.



salmon above all else. They fear that the Pebble mine would destroy the fishery, largely by contaminating the water. The Pebble partners argue that extractive industry and wildlife can coexist and that the mine would bring much needed economic benefits. Framing this as “mine versus salmon,” however, overlooks the project’s larger potential effect: It could stimulate industrial growth on a scale that would permanently transform the Bristol Bay region.

AT ONCE ROUTINE AND ASTONISHING, and even more astonishing for being routine, the summer sockeye run has started. Monitors at Port Moller, out on the Alaska Peninsula, have sent word that the initial numbers are in keeping with those of past seasons—and increasing steadily. From Naknek, south of the Kvichak River, to

Edwin Dobb has written about mining in his hometown of Butte, Montana. Michael Melford’s Hidden Alaska, Bristol Bay and Beyond will be published next spring by National Geographic Books.

Dillingham, at the mouth of the Nushagak, all of coastal Bristol Bay is high on anticipation.

Among the first to get their nets wet are the subsistence fishers who live on and near the bay. For thousands of years the indigenous Yupik have depended on salmon, along with pike, whitefish, beavers, caribou, moose, berries, and plants such as wild rhubarb. “We share with the whole village,” says Luki Akelkok, Sr., a 72-year-old Yupik patriarch. Yes, adds Bobby Andrew, who’s in his late 60s, “we give away our first big game. It always comes back.”

Akelkok and Andrew are escorting me by jet boat to Lewis Point, a long gravel beach that salmon swim past on their way upstream. Close enough to the bay to lie within the tidal zone, the river here is broad, muddy, and in places dangerously shallow, so Akelkok approaches gingerly. Every summer people from nearby villages gather at this spot to fish for sockeye and, more important, for kings, the largest of the salmon and the first to return to Bristol Bay, in early June. The men anchor one end of a setnet

“This is nirvana for trout and salmon fishermen,” says guide Nick Jackson (below), holding a 27-inch rainbow caught at the mouth of Upper Talarik Creek. Far upstream, near the mine site, researchers found young salmon and trout (left) in the unprotected creek.



onshore, pull the other end into the water, allowing the current to lift and unfold it, then wait until the fish swim into the webbing, which catches their gills. Arrayed along the riverbank are wooden sheds where women fillet the salmon and hang the narrow strips to dry in preparation for smoking. Since long before statehood and oil royalties, long before Russian explorers introduced Christianity to Alaska, this scene has played out in this place. But now the two elders believe the threat the Pebble mine poses to the creeks, rivers, and lakes where salmon spawn also endangers the culture the fish have sustained for centuries. “Once that’s gone,” Akelkok says, referring to the region’s biological vitality, “you can’t get it back.”

Nothing about the condition of other once robust salmon fisheries in the lower 48 contradicts Akelkok’s view. In the Columbia River Basin the four horsemen of fisheries collapse—habitat degradation, dams, weakening of the genetic pool through the use of hatcheries, and overharvesting—have destroyed the salmon

stock in dozens of places and reduced the rest to remnants. That’s the grim backdrop for the increasingly contentious debate in Bristol Bay, one of the few places left where the condition of the fish can be discussed without using the word recovery. Bristol Bay still possesses what has been squandered elsewhere—abundance.

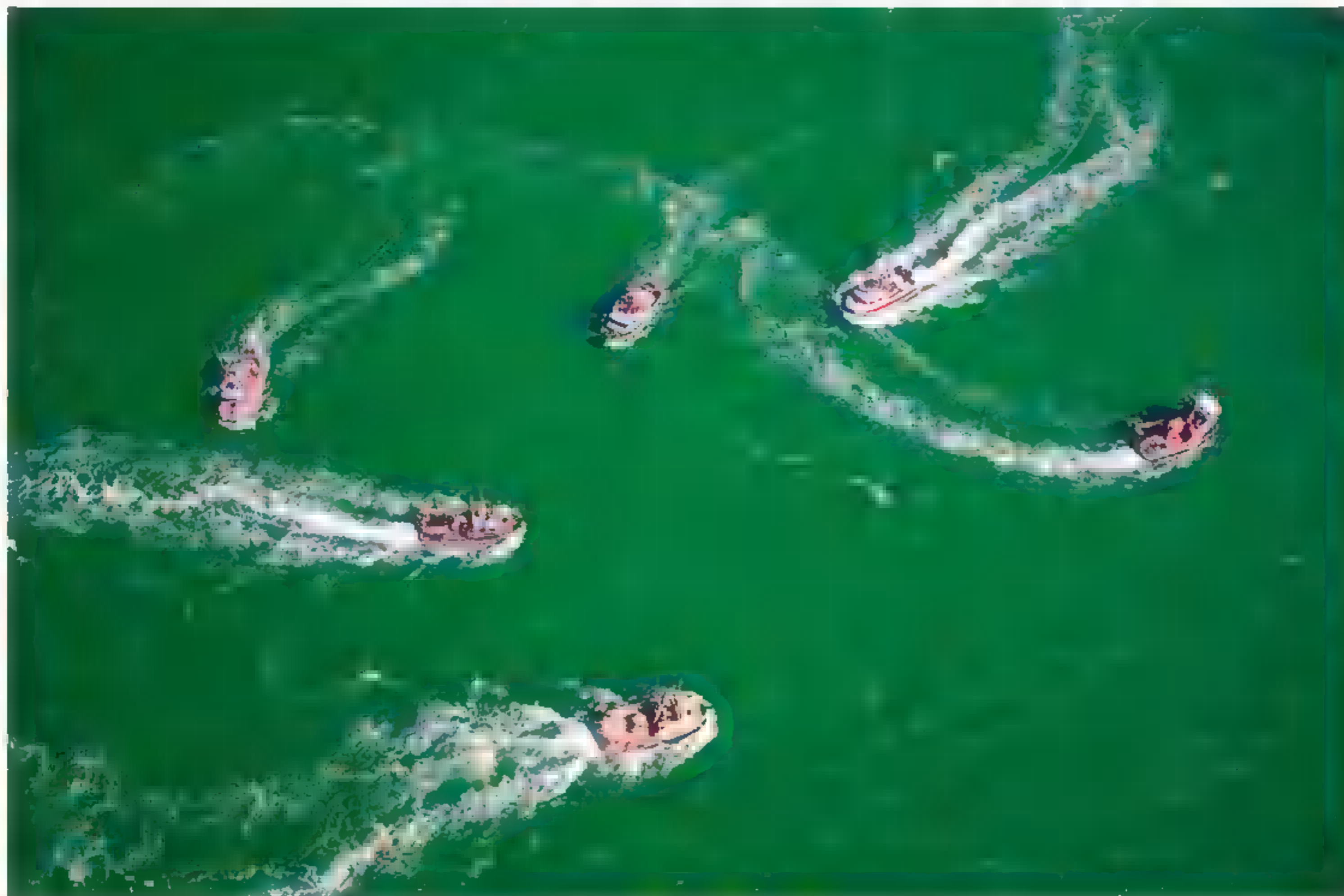
Of all the millions of sockeye that return each year and survive the gantlet of commercial and subsistence fishing in the bay, at least a million will enter the Wood River, a tributary of the Nushagak. That’s a single-river population at least ten times greater than the recent annual returns for the entire Columbia River system. And unlike most other surviving runs in the U.S., which include hatchery-raised salmon, the Wood River population is completely wild.

More than differences in ecosystem integrity explain this wide gap in productivity. In Bristol Bay, fishery managers have limited the length of gill nets, the number of fishing permits, and the length of commercial boats. But the real genius of salmon management here is the strict use of



People aren't the only ones catching Bristol Bay salmon. A coastal brown bear grabs lunch at Brooks.





“escapement numbers”—daily tallies of fish entering major spawning rivers—to determine how many can subsequently be taken by commercial, subsistence, and sport fishers. Escapement goals are based on long-term observations of the number of fish required to guarantee that, as Bobby Andrew says, “they always come back.” The 2009 goal for sockeye on the Kvichak was 2,650,000; for the entire Bristol Bay watershed, it was 8,750,000.

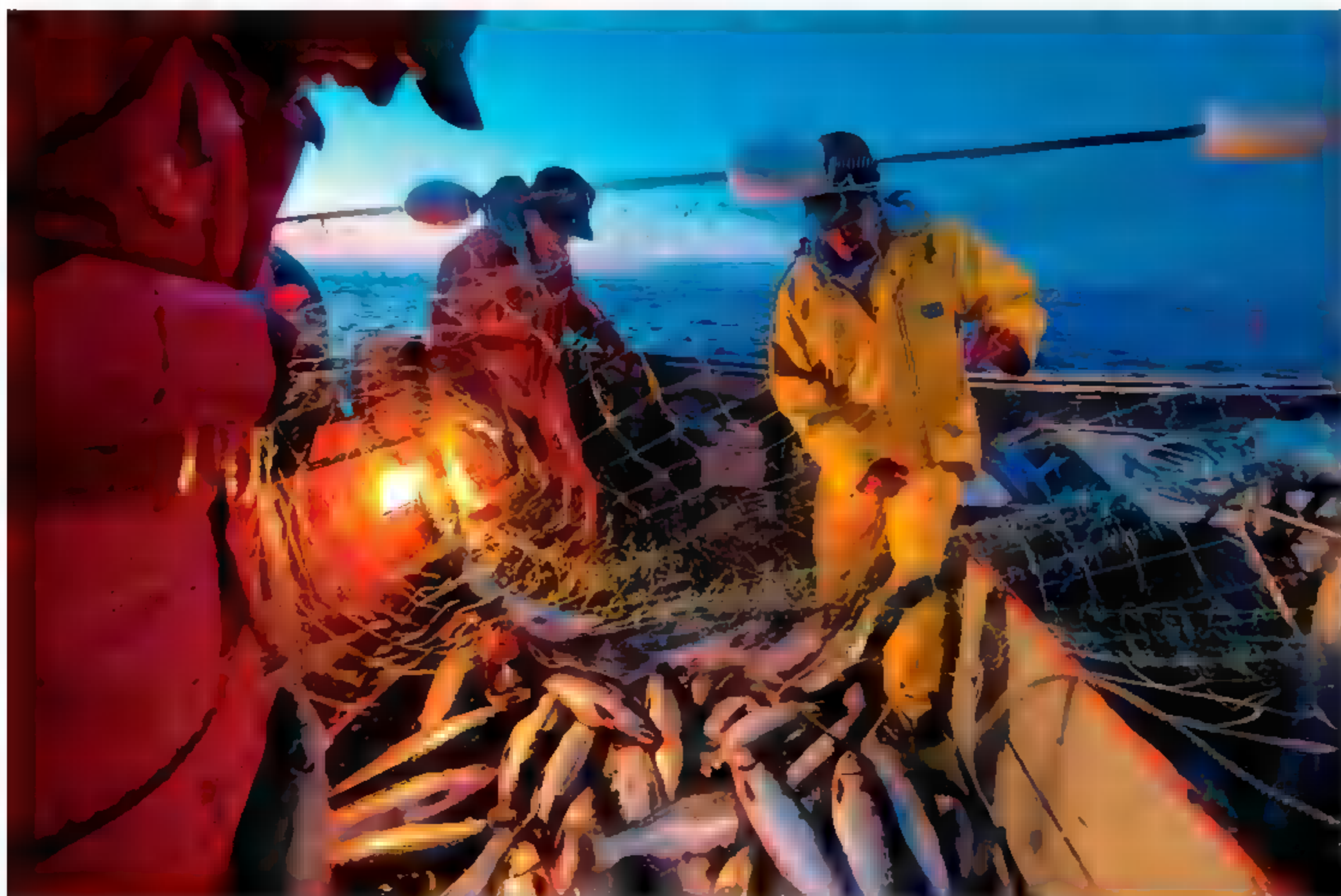
What escapement-based management means in practical terms is that during the sockeye season—generally from mid-June to late July—those who rely on the fish live by the tides, because tides carry each pulse of salmon toward the headwaters. Whether it’s the Bouker family with a setnet on the beach at Ekuk, targeting salmon headed for the Nushagak drainage, or Everett Thompson and his drift boat outside the mouth of the Egegik River, the commercial fishers of Bristol Bay can fish only during “openings,” announced over the radio by state officials. Openings usually last six or more hours and can

occur once or twice a day, or not at all for days at a time. They are periods of frenzied labor and, for those who are adept—and lucky—jubilation.

“It’s like Christmas morning!” exclaims a radiant Ina Bouker, as she watches heads and tails splashing along the top of her net, held up by small buoys that stretch out into the spangled water. If so many fish are entangled near the surface, many more must be caught below. Indeed, as the incoming tide slackens, the net is so heavy with sockeye that Ina’s husband, John, hitches it to a four-wheel-drive truck and drags it onto the shore. During this six-hour opening, Ina and John and their six children will harvest 18,000 pounds of fish from two nets. Across the bay Everett Thompson and his drift-net crew are well on the way to a 220,000-pound season, their best ever. “I love fishing,” Thompson says. “Sometimes it feels like work.”

Thompson and Ina Bouker have been netting salmon since they were kids, and although they’re rooted in the subsistence tradition, they’re mainly commercial fishers. During

In Bristol Bay a tired but determined crew (below) hauls in a thousand pounds of sockeye before dawn. Fishing boats jockey for position (left) during flood tide, when returning salmon pour into the bay. "If you live in the area, you're somehow tied to fishing," says Everett Thompson, of Naknek.



the sockeye season, Thompson earns enough money to support himself and his daughter; during the off-season, he hunts moose, caribou, and other wild game to supplement their diet. The Boukers own an air-taxi service and a construction company, but they use some of the income from fishing for their children's college fund.

NOT EVERYONE IN THE Bristol Bay watershed can rely on biological abundance to stave off hardship. Near the Pebble deposit, far from the fisheries on the bay, fuel and food are painfully expensive, and stable employment scarce. Myrtle Anelon, a 68-year-old Alaska native who owns a bed and breakfast in Iliamna, says the Pebble Partnership is the first outside economic business to take an interest in her community's welfare. "The others make money in our backyard," she says, referring to seasonal residents who own lodges that cater to high-end sport fishers, "but they don't hire locals, they don't buy from us."

Anelon's daughter, Lisa Reimers, who heads the Iliamna Development Corporation, is concerned. "Outsiders want us to go back to the old ways," she says, explaining that some mine opponents promote a self-serving, sentimental view that ignores what it actually takes to survive. To be sure, those who live in the Iliamna Lake area do still practice subsistence fishing—Anelon tends to a family setnet just outside town—and they treasure the wild habitat that supports it. But they also have truck payments, mortgages, and medical bills to pay. They want to send their kids to college. They need cash. "What's their plan for us?" Reimers asks of those who condemn her and others like her for welcoming mining jobs. "Without Pebble, what do we do?"

These are the people John Shively, CEO of the Pebble Partnership, has in mind when he touts the benefits of prolonged, large-scale mining at the headwaters of an incomparable sockeye fishery. Having arrived in Alaska as a VISTA volunteer more than 40 years ago, Shively has held high-level state government positions,



Like his Dena'ina ancestors, Luther Hobson checks the salmon in his smokehouse for dryness. In his



village, Nondalton, most residents favor their subsistence lifestyle over the promise of mining jobs.

“Everything humans do entails risk,” John Shively observes. The question, of course, is whether what would be gained from the Pebble mine would outweigh the possible costs.

including commissioner of the Department of Natural Resources. He has also worked with native groups to promote development in rural areas, a long-standing interest the Pebble mine allows him to pursue. The mine would provide some 2,000 construction jobs and 800 to 1,000 operating jobs. Shively wants more than half the operating positions to be filled by people who live around Bristol Bay, which has only about 6,900 residents. Other benefits would include income for local retailers and suppliers, though few such businesses exist today, as well as revenue for the state and for local governments from taxes and royalties.

We all rely on base metals. Cars, computers, and other common electrical devices at our disposal require copper. What’s more, says Mike Heatwole, vice president of public affairs for the Pebble Partnership, “copper is one of the building blocks of the green economy.” Wind turbines, for example, can use thousands of pounds apiece. Heatwole, two of his co-workers, and I have arrived by helicopter at a bare hill overlooking the site of the proposed mine. Buried beneath the ground here are an estimated 40 million tons of copper, 107 million ounces of gold, and 2.8 million tons of molybdenum (used as a hardener in lightweight alloy products like surgical instruments). The value of this mother lode ranges between \$100 billion and \$500 billion. But unlike the value of the salmon fishery year in and year out—upwards of \$120 million—once these geologic riches are gone, they will never come back.

The deposit is divided into two sections—a western district, where the ore could be extracted

by open-pit mining, and an eastern district, where the ore is deeper and would require an underground operation. Particulars will not be revealed until 2012, when the partnership submits its official plan to state regulatory agencies to start the permitting process, but the general outline, based largely on documents Northern Dynasty released several years ago, may look like this: Besides two large mines, the complex likely would include a mill to crush and separate metals; immense damlike impoundments to contain the fine-grained waste, or tailings, from the mill; a slurry pipe to transport the milled ore to Cook Inlet; a deepwater port on Cook Inlet; a haul road along the same corridor; and 250 to 300 megawatts of power, generated either on-site or outside the region.

“THE ONLY PLACE WORSE to put a mine would be my living room.” That’s what former Alaska governor Jay Hammond said of Pebble, according to his widow, Bella. Considering that their living room is yards away from wild and remote Lake Clark, across from the glacierbound peaks of the Chigmit Mountains, Hammond couldn’t have issued a stronger indictment. Of the many threats posed by the mine—disruption of spawning grounds along the haul road (which would cross scores of streams), draining of spawning grounds (including Upper Talarik Creek) near the mine, the outright destruction of spawning grounds within the mining complex—what concerns people most is acid mine drainage. When a sulfur-bearing ore such as the Pebble deposit is exposed to air and water, it produces sulfuric acid, which accelerates the dissolution of copper and other minerals. The resultant metal-laden, acidic cocktail can kill fish and other organisms.

From its uppermost reaches near the mine site, Upper Talarik Creek is just 35 miles long, yet in recent years 20,000 to 100,000 sockeye have returned annually to this stream to spawn. And they have attracted thousands of rainbow trout, which feed on salmon eggs. The creek is connected to the South Fork of the Koktuli River, a king salmon spawning stream, because

water seeps from the Kuktuli under a ridge into Upper Talarik. Surface water becoming groundwater becoming surface water again is one of the features of the country north of Iliamna Lake—and it's why sockeye favor this body of water. Springs replenish the gravel-bottomed shores of the lake's islands with highly oxygenated water, which salmon eggs need to mature. Any accidental acid mine drainage into this intricately connected natural system could be disastrous.

John Shively insists that mine design today is more environmentally sensitive than ever before. And he's right. Even though the official plan has yet to be revealed, some basic assumptions are reasonable. During operations, the pit would act as a sump, drawing groundwater into it. The water would either be cleaned and discharged or recycled for use in running the mine. Tailings impoundments—the largest possibly more than three miles long and 700 feet deep—would be closely monitored for leaks, but controlling any unseen seepage would be difficult. Short of an earthquake strong enough to breach an impoundment, which seems highly unlikely, the chances of an environmental catastrophe occurring while the mine is running would be slim. Allowing for three years to complete the permitting process and another three for construction, the partnership estimates that production could not begin until 2017 and that it would go on for 25 years or more. In other words, Pebble is unlikely to cause any large-scale, long-term damage until at least 2040, even if the mine expands, as most such mines do. This means that the more alarmist of the opponents are mistaken: The fisheries are not in immediate danger.

But after the mine closed, the partnership would have to guarantee the integrity of the impoundments, as well as the efficacy of the plant treating the polluted water in the idle pit, from shutdown day onward—in perpetuity. No one disputes this. Indeed, a recent addition to the requirements for permitting is that companies develop a mine-closure plan that includes perpetual monitoring and maintenance, and that they post a bond to cover some of those costs.

Contemporary mine plans also differ from past ones in that they must include provisions for environmental mitigation if habitat is damaged, a policy sometimes referred to as “no net loss.” It's a given that the partnership would compensate for the wetlands destroyed for the mining complex, which could encompass more than 30 square miles, although Shively says it would be less than half that. But the bounty of Bristol Bay owes as much to the genetic variety of the fish as to their quantity. Biologists have established that this biocomplexity is responsible for the consistently high productivity of the watershed. From year to year, the number of sockeye that return to any one stream may vary widely, owing to natural causes, while the total return is much less variable. To sustain Bristol Bay's fertility, the whole genetic portfolio, in all its variety, must be protected. Making up for spawning areas that become degraded by restoring others, as if all salmon were interchangeable, would render the overall watershed less resilient. Here, the principle of no net loss could yield the most damaging kind of net loss.

“Everything humans do entails risk,” Shively observes. The question, of course, is whether what would be gained from the Pebble mine would outweigh the possible costs. Many deem it foolish in the extreme to construct mammoth tailings impoundments that must never fail—not ever—in a place where all the water is interconnected and the well-being of the world's largest salmon run depends on the whole ecosystem remaining intact.

THE REASONS FOR CONCERN don't end there. No mining enterprise of such grand ambition has been attempted anywhere else in Alaska, and this one is so big it could amount to an economic tsunami. The partnership holds leases on 180 square miles, and other companies have staked claims that could result in mining operations in a district spanning hundreds of square miles. In the final days of the George W. Bush Administration, the U.S. Department of the Interior recommended that 1.1 million acres of



Chikuminuk Lake reflects the raw wilderness in 1.6-million-acre Wood-Tikchik State Park. One of the



largest state parks in the U.S., it is home to five species of salmon as well as moose, caribou, and brown bears.

Bureau of Land Management land in the middle of the Bristol Bay watershed be opened to mineral exploration and that a section of the bay itself be opened to offshore oil and gas production. The Obama Administration has rejected both proposals, but either could be revived.

If the partnership's vision for Bristol Bay comes to fruition, wider changes will surely follow. "We will bring inexpensive power to the region," Shively says. By that, he means not only to the headwaters area around the mine but to Dillingham and Naknek too. A deepwater port near Williamsport, on Cook Inlet, and the haul-road corridor might be first steps leading to the creation of new towns and industrial enterprises in the watershed.

"It'd make me sick to see a highway coming through this land," says Bella Hammond's 23-year-old granddaughter, Lauren Stanford, sitting in her grandmother's kitchen on Lake Clark. "RVs don't belong here."

Aware that much more is at stake than one huge mine, many opponents are campaigning for the creation of a regionwide conservation zone. It would be modeled after the Bristol Bay Fisheries Reserve, which encompasses the entire watershed and within which petroleum extraction is effectively banned. In the conservation zone, large-scale hard-rock mining would also be prohibited, though small, environmentally friendly projects would be allowed. Bills to restrict Pebble-scale mining have been introduced in the Alaska legislature. Backers hope that as more people learn about the project and its possible impact, support for a reserve will grow.

To be effective, to say nothing of fair, any plan for preserving the Bristol Bay ecosystem must also ensure a viable economy for the hard-pressed residents of the watershed: jobs and small-business opportunities in the recreation and tourism industry, such as guiding and outfitting, and mechanisms for locals to buy back some of the hundreds of commercial fishing permits now owned by outsiders. Incentives for the direct marketing of salmon would help, by allowing the people who catch the fish to bypass the big processing plants and sell



An exploratory drill rig pumps water as it probes the Pebble deposit. Demand for gold and copper, used in most things electric, is fueling the project. But with fishermen, environmentalists, and some jewelers arrayed against the mine, its future—and that of Bristol Bay's salmon—remains uncertain.



straight to consumers, thereby receiving a larger share of the profits.

“THIS IS THE RIGHT ALTITUDE,” Rick Halford says, guiding the Cessna sharply upward, over a snow-packed saddle between two jagged black peaks. “It gives you perspective without losing connection.” Viewed from the air, the rough portage road that links Pile Bay Village on the east end of Iliamna Lake to Williamsport on Cook Inlet seems benign. Only 16 miles long, it winds through a narrow stretch of the Chigmit Mountains that fill Bella Hammond’s living room window. Since the late 1930s, people have

used the road to transport everything from fuel and equipment to fishing boats destined for the bay. But this modest track would be the first leg of the 86-mile infrastructure corridor the Pebble Partnership has envisioned if the mine is approved.

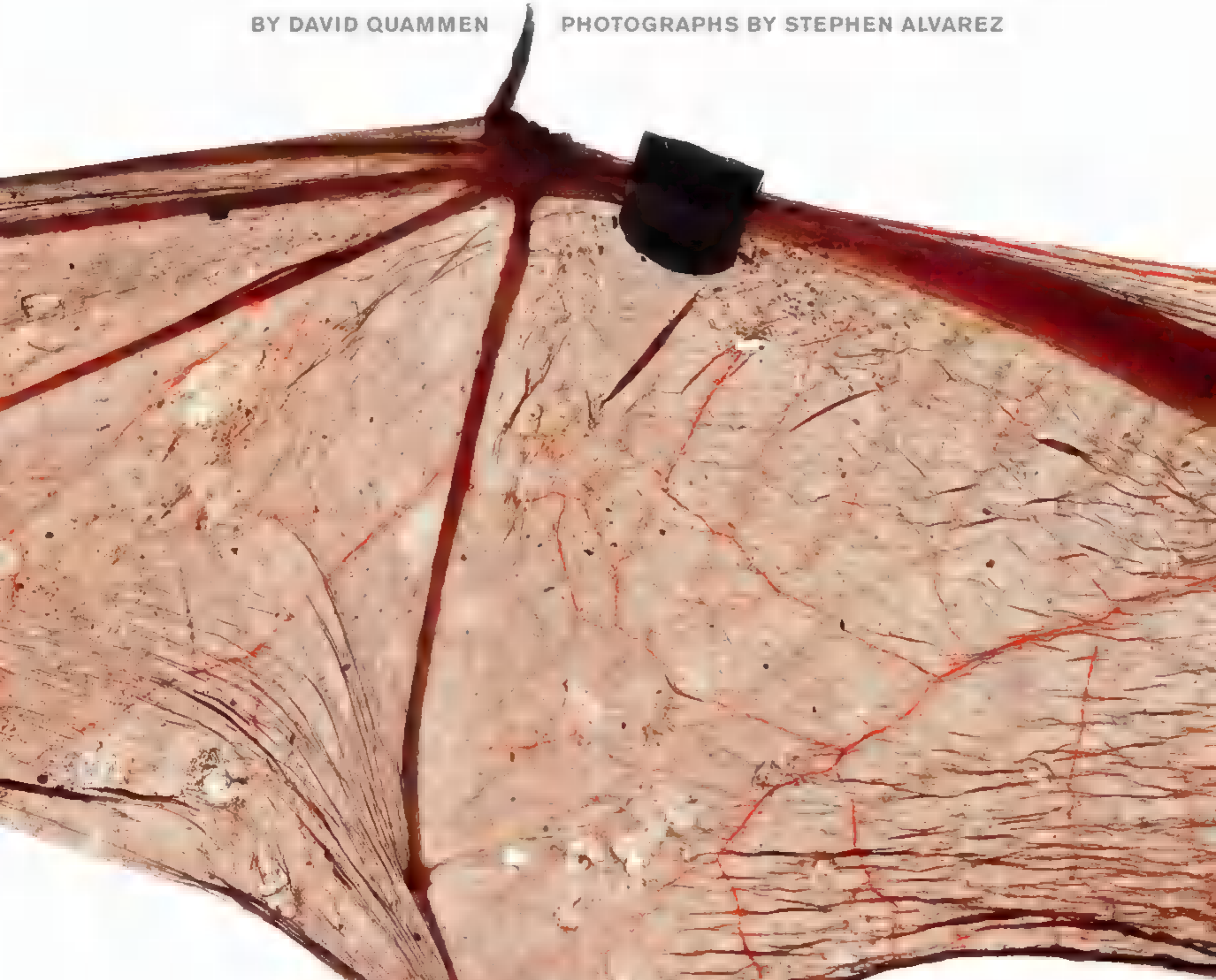
We descend, approaching the edge of Cook Inlet. Just across the frigid, glacier-fed water, ■ mere 70 miles away, is Homer, which now, thanks to an improved highway, is an easy drive from Anchorage. Everything that could transform Bristol Bay is exactly that close.

“It’s time to decide,” Bella Hammond says, “what we value most.” □

BATS ARE CRUCIAL TO ECOSYSTEMS—DEVOURING INSECTS, DISPERSING SEEDS, AND POLLINATING FLOWERS. BUT IN THE U.S. AN INSIDIOUS NEW ENEMY IS CAUSING MASSIVE DIE-OFFS.

BY DAVID QUAMMEN

PHOTOGRAPHS BY STEPHEN ALVAREZ



Crash



DAMAGE IS VISIBLE ■ THE WING MEMBRANE OF A LITTLE BROWN BAT THAT DIED FROM A MYSTERIOUS DISEASE.



FATEFUL SIGN

Little brown bats wintering in a West Virginia cave called Hellhole, the state's largest hibernaculum, show the fungus that gave white nose syndrome its name. Intimate behaviors, such as dense roosting, allow the fungus to spread.







BAT SURVEY

In a census of gray bats in Hubbard's Cave, Tennessee, last winter, biologists counted individuals in small areas, then extrapolated. The estimate: 300,000 in this cluster and 513,000 in the entire cave. The fungus hasn't affected this endangered species—yet.

O

n the outskirts of Madison, Wisconsin, stands a low brick structure equipped with ventilation scrubbers and surrounded by a tall chain-link fence: the Tight Isolation Building of the U.S. Geological Survey's National Wildlife Health Center (NWHC), a federal research facility devoted to combating wildlife diseases. Inside, a cinder block corridor circuits the Animal Isolation Wing, passing a series of well-sealed experiment rooms, each visible through a thick window. One room is furnished with sawdust and burrow-like pipes to approximate the habitat for prairie dogs involved in a vaccine trial against *Yersinia pestis*, the organism that causes plague. In another room zebra finches in birdcages are playing a role in research toward a vaccine for West Nile virus. Two rooms are darkened, for the comfort of hibernating bats. The first contains normal animals of the species *Myotis lucifugus*, commonly called little brown bats. They are the controls. The second dark room houses little browns exposed to *Geomyces destructans*, a filamentous white fungus of unknown origin that first appeared among North American bats in 2006. In just four years, it has hit hibernating bat populations in New York, Vermont, and a growing list of other states and Canadian provinces more lethally than *Yersinia pestis* hit the peasants of medieval France.

David S. Blehert, a microbiologist at NWHC, leads the laboratory study of this nefarious fungus. He enters the second dark room wearing Tyvek coveralls, rubber boots, latex gloves, a red-filtered headlamp, and a respirator. Moving quietly to avoid rousing the animals, he approaches a large glass-fronted cabinet in which sits a small, screened cage of bats. The cabinet is a florist's refrigerator, adopted by Blehert because hibernating bats, like cut lilies, do best at low temperatures and high humidity. Blehert peers into the cooler, checking the bats for evidence of fungal growth around their muzzles or on their wings. White fuzz on the snout, which looks like

Contributing writer David Quammen wrote the October 2007 article "Deadly Contact," about zoonotic diseases. Stephen Alvarez photographed Madagascar's "stone forest" in November 2009.



rime on the beard of a skier, is a signal that the bat may be infected; it's also the source of the label "white-nose syndrome" for this affliction.

No sign of change, Blehert tells me back in the locker room. No mortalities so far, and no visible fungus. But the experiment is still in an early stage.

How does this fungus kill the bats? "That we don't know," he says. "It is, I believe, the first disease ever characterized specifically targeting a hibernating animal." So its mode of lethality may be different from anything science has ever seen. And that's only one of the unknowns.



THE FUNGUS ITSELF seems to be new to North America. Its presence was first documented—but not yet recognized—in a photograph taken in February 2006 at Howes Cave, west of Albany, New York. A year later, people began to report something peculiar: little brown bats flying outside nearby caves during daylight in the midst of winter. A little brown bat is a tiny creature, smaller than a human thumb, and dependent on its two grams of stored fat to keep it alive through the cold season. Hibernation is essential to making its energy resources last;

GRIM EVIDENCE

Greg Turner, of the Pennsylvania Game Commission, and DeeAnn Reeder (at left), a biology professor at Bucknell University, find a fetid mulch of dead bats outside a coal mine in eastern Pennsylvania. "I'm not a sky is falling person," Reeder says. "But for North American bats, the sky is falling."

Hibernation sites in the West are poorly known.

Howes Cave
First signs of white-nose syndrome, February 16, 2006

Hailes Cave

ATLANTIC OCEAN

Hellhole

Hubbard's Cave

Diseased species and their ranges
Of the two dozen species that hibernate in caves, six have WNS, and the rest may be in jeopardy.



Big brown bat



Eastern small-footed bat



Indiana bat



Little brown bat



Northern long-eared bat



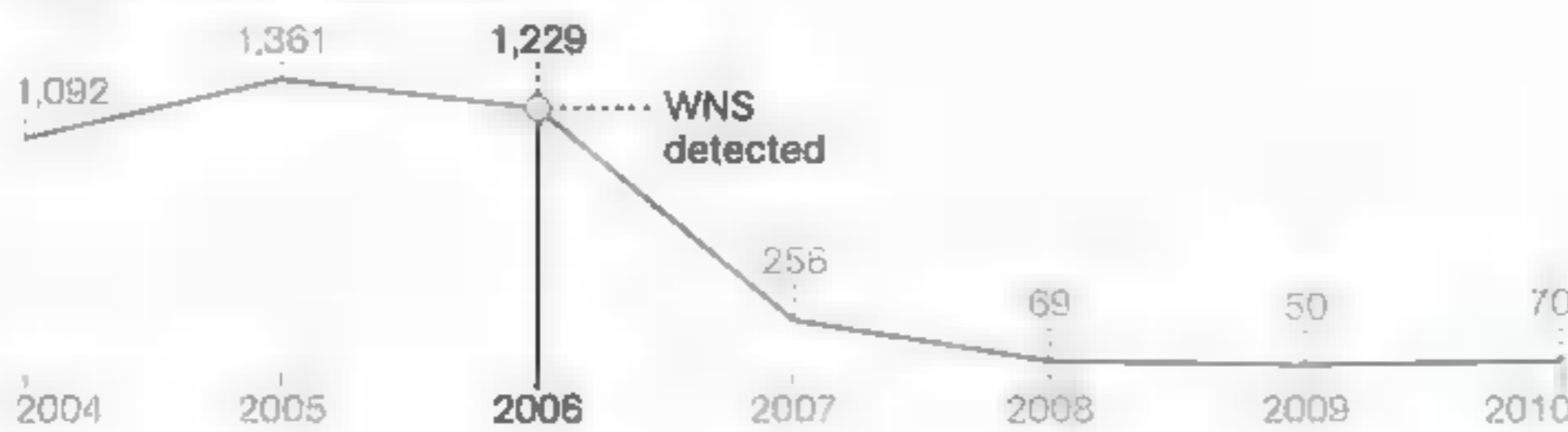
Tricolored bat



Caves with bats affected by white-nose syndrome (WNS)

- | | |
|--------------------|---|
| WNS present | Fungal DNA present |
| ○ 2006-07 | ▲ 2009-10 |
| ◐ 2007-08 | (Presence of the fungus <i>Geomyces destructans</i> can lead to WNS.) |
| ● 2008-09 | |
| ● 2009-10 | ■ Hibernation areas where bats are at risk. |

Howes Cave population



SPREADING THREAT

The precipitous decline of little brown bats in Howes Cave in New York State reflects the catastrophic effect of white-nose syndrome on hibernating species. Recent surveys indicate that the disease has spread far from there and much faster than anyone had expected. With no end in sight, extinctions are possible.

MAPS: LISA RITTER, NGM STAFF; MAGGIE SMITH
SOURCES: JEREMY COLEMAN, U.S. FISH AND WILDLIFE SERVICE; BAT CONSERVATION INTERNATIONAL; USGS
ART: DAVID BYGOTT. CHART: MARIEL FURLONG, NGM STAFF. SOURCES: ALAN HICKS, NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION; KEVIN BERNER, STATE UNIVERSITY OF NEW YORK AT COBLESKILL

a single arousal can cost it a month's worth of fat. When a crew from New York's Department of Environmental Conservation made their routine annual inspection of Hailes Cave, another hibernaculum nearby, they found thousands of dead bats, scattered all over the cave, in various stages of deliquescence and decay. "It was carnage," according to Al Hicks, a mammal specialist with the department.

Since then, the problem has spread quickly and far. Biologists estimate that a million or more animals were lost in three years, with populations at some sites eliminated. Six species have the disease, one of which had been declared endangered long before white-nose syndrome: the Indiana bat (*Myotis sodalis*). Three others are at very high risk, including the gray bat (*Myotis grisescens*), also endangered. Great progress was made within recent decades in restoring gray bat populations. "We've put enormous effort in this," says Merlin Tuttle, founder of Bat Conservation International. "It could now be unraveled in just a few years."

It's hard to foresee where *Geomyces destructans* might stop, short of infecting every population of hibernating bats in North America. Harder still is to say what, if anything, can be done to mitigate the destruction.

HIBERNATION—that's a crucial piece of the problem. Fungi generally don't cause severe disease in warm-blooded creatures (nobody dies of athlete's foot) because high body temperatures aren't conducive to runaway fungal growth. Hibernation, on the other hand, entails lowering of body temperature along with other parameters of metabolism, such as breathing rate and heart rate. Of the 45 bat species resident in the United States and Canada, about two dozen hibernate. They congregate in caves, mine shafts, and even buildings, each hibernaculum chosen according to species-specific requirements of temperature range and humidity. Little brown bats prefer temperatures between 40° and 45°F and humidity around 90 percent. Those conditions are also optimal for *Geomyces destructans*, as David Blehert has discovered while working to grow it in his lab.

But a fungus needs nutrition as well as a comfortable environment. It takes its food from other creatures. Ordinarily, the immune system of any mammal will work to fight off a fungal parasite. Not necessarily, though, if the mammal is hibernating. Work done in the lab of Tom Kunz, a bat researcher at Boston University, suggests that a side effect of hibernation—when a bat dials down its metabolism—might be suppression of its immune responses. Marianne Moore, a biologist in Kunz's lab, wonders whether that immune suppression, amid the cool temperatures, is what allows *Geomyces destructans* to bloom so aggressively on wintering bats. (Humans aren't susceptible.) This newest addition to the *Geomyces* genus seems to have found its way to the one group of mammals least capable of defending against it.

Found its way—from where? No one knows. The same fungus has been seen on bats in Europe, but there it hasn't caused any noticeable disruptions or deaths. In other words, the fungus is present but not the syndrome. White-nose syndrome means not just fungus-frosted snout fur but also corrosive white lesions on the wings of the bat and untimely arousal from hibernation, possibly because the white stuff is irritating, stifling, or itchy. The wing lesions impair flight; the untimely arousal costs bats their fat reserves, exposing them to starvation or freezing, whether or not they emerge from the cave in a desperate, futile search for food. At what point, and why, does an annoying fungal infection develop into full-blown white-nose syndrome? Again, nobody knows.

Bats don't fly across the Atlantic, so if *Geomyces destructans* reached Howes Cave from Europe, it was probably carried there by a human—a tourist with dirty shoes, maybe, or a caver in fungus-flecked coveralls. Seen in that light, it's just the latest in a long list of devastating invasive species. A century ago the culprit was another fungus, *Cryphonectria parasitica*, better known as chestnut blight. Before it arrived, American hardwood forests were full of tall, stately chestnuts, but by 1940 those trees were virtually gone.

"THIS IS THE CHESTNUT BLIGHT of bats," Jim Kennedy says, as we drive toward Hubbard's



Cave, a gray bat hibernaculum in central Tennessee. Kennedy is a biologist and a caver, employed by Bat Conservation International. His job involves teaching other biologists and cavers how to census bat populations in hibernacula with minimal disruption and, in the process, to chart the spread of white-nose syndrome. He thinks like an ecologist, concerned not just for bats but for the ecosystems in which they participate—living caves, forests, farmlands. By one estimate, the million bats lost so far to white-nose syndrome would be consuming about 700 tons of insects a year. “We may see big, big changes,” Kennedy adds. “There’s no predicting.”

Beyond the unsolved riddles of the disease itself is another: What might America look like without any hibernating bats?

Hubbard’s Cave, which the Nature Conservancy owns, is naturally concealed at the end of a mountain road. A stream descends through a wooded gulch, then cascades into a sinkhole, along the bottom edge of which are three cave entrances opening deep within the caved limestone. All are blocked with huge steel gates that allow bats to fly in and out but exclude unauthorized human visitors. We climb down an aluminum ladder into the sinkhole. Then our host from the Nature Conservancy unlocks a panel at the



COLD KILLER

*In a lab at Boston University, biologist Jonathan Reichard has prepared bat remains (left) for heat processing to render away their fat. By weighing them before and after the procedure, he can determine their fat content and deduce how badly the fungus had weakened them. A little brown bat in Pennsylvania (below) struggles in the snow against the effects of untimely arousal, caused by the disease. The fungus *Geomyces destructans* may not kill bats directly, but disturbance, activity, wasted energy, and hunger in winter add up to doom.*



bottom of one gate, and eight of us—bat counters and others—wiggle through. Every item with us, including my waterproof notebook, will be bagged in plastic when we exit and later disinfected. If the fungus lives in this cave, Jim Kennedy and his colleagues won't carry it into the next.

We explore the several passageways amid thousands of roosting gray bats, not one of which—so far as anyone can see—has a whitened nose. There is no ragout of dead bats on the floor. We have arrived before the fungus. But Kennedy isn't sanguine. "It's not *if* it gets here. It's *when* it gets here. We're bracing ourselves for that," he says. "This cave alone has half a million bats."

While Kennedy and the others work, I linger before an astounding sight. On the tan limestone wall of one chamber, lit dimly by the ricochet of our headlamps, hangs a single thick mass of gray fur. It's a cozy, inert aggregate of living bat bodies, clinging two-deep, three-deep, and cheek by jowl with one another, their little clawed feet hooked to the porous vertical rock. They form a solid, irregular patch, as big as a living room carpet. This single patch, I'm told, might encompass 300,000 bats. It resembles a buffalo robe. It resembles a huge, dark amoeba. It puts me in mind of a giant Rorschach blot, testing our visions of the future. □





On Botswana's Duba Island, lions risk their lives to prey on African buffalo.

BOTSWANA

Protecting Predators

Dereck and Beverly Joubert have devoted their lives to the belief that big cats matter. Here's why.

THE EXTRAORDINARY ANIMAL THAT CHANGED OUR lives was still a wobbly, half-blind, eight-day-old cub when we encountered her with her mother in Botswana's Okavango Delta in 2003. We'd been working for many years with big cats in Africa and had developed broad-stroke conservation ideas. But when we met this baby leopard we called Legadema (Setswana for "light from the sky") and followed her for nearly five years, she taught us something fundamental about all big cats:



While we go about conservation, we often forget that beyond the alarming numbers, there are individuals with personalities and intricate lives. As their numbers decline, conservation becomes more about saving these individual animals.

Legadema grew up to be magnificent.

She's seven now, and thriving. She's become mother to at least two litters. We still visit her from time to time. But in the years that we've known her, other leopards have been less fortunate. The Convention on International Trade in Endangered Species (CITES) has set quotas that *(Continued)*

Society Grant The Jouberts' big cats work is funded in part by your National Geographic Society membership.



**Without lions, the ecosystem collapses.
Everything unravels. If we can't protect this species,
what hope is there for the rest? —DERECK JOUBERT**



An uncertain future faces lion cubs like this one, born on Duba Island.



permit the export of up to 2,653 leopard trophies a year. Poaching and the trade for skins used in rituals and ceremonies take a toll as well. Although precise numbers are difficult to pin down, our research indicates a drop in the number of leopards left in the wild.

Working with Legadema and becoming explorers-in-residence at National Geographic turned us into advocates. It inspired us to launch National Geographic's Big Cats Initiative (BCI) as an effort to save these top predators. Big cats are keystone species that support the African and Asian ecosystems. Without these animals, vital wilderness areas are vulnerable to collapse. Protecting the majestic lion—Africa's iconic predator, at high risk of extinction—is a major priority. If humans were systematically trying to eradicate these animals, we couldn't be doing a better job. Most people assume that there are a lot of lions left and that someone is taking care of their conservation. The truth is we've seen lion numbers decline drastically in our lifetimes. At this rate, we fear that lions could soon vanish. Without lions, the ecosystem collapses. Everything *(Continued)*

Cat Count

As Africa's human population has increased to more than a billion, lion ranges and numbers have shrunk. The same is true for big cats elsewhere.

Lions remaining

30,000



Threats to lions

- Human conflict
- Loss of habitat
- Prey decline
- Trophy hunting
- Pesticide poisoning
- Tuberculosis

Conservation strategies

- Reduce human-lion conflict by protecting against livestock loss
- Ban hunting and arrest poachers
- Ecotourism



John-Joseph van Haelewyn

John McCallister included National Geographic in his estate plans.

Inspire Future Generations

An avid traveler and horticulturist, John McCallister was introduced to National Geographic when his aunt sent him a gift subscription to the magazine in the 1940s. "I like everything about National Geographic, what it stands for, and what it accomplishes," John says.

Now retired, John spends his time taking continuing education classes, landscaping his garden, and frequenting art museums, theatre performances, and concerts. John made a bequest gift as a way to support the things he holds dear. "I included National Geographic in my will because I want the Society to be around for future generations," he says.

For more information about how to include us in your estate plans, or to let us know that you have already done so, please contact the Office of Estate Planning.

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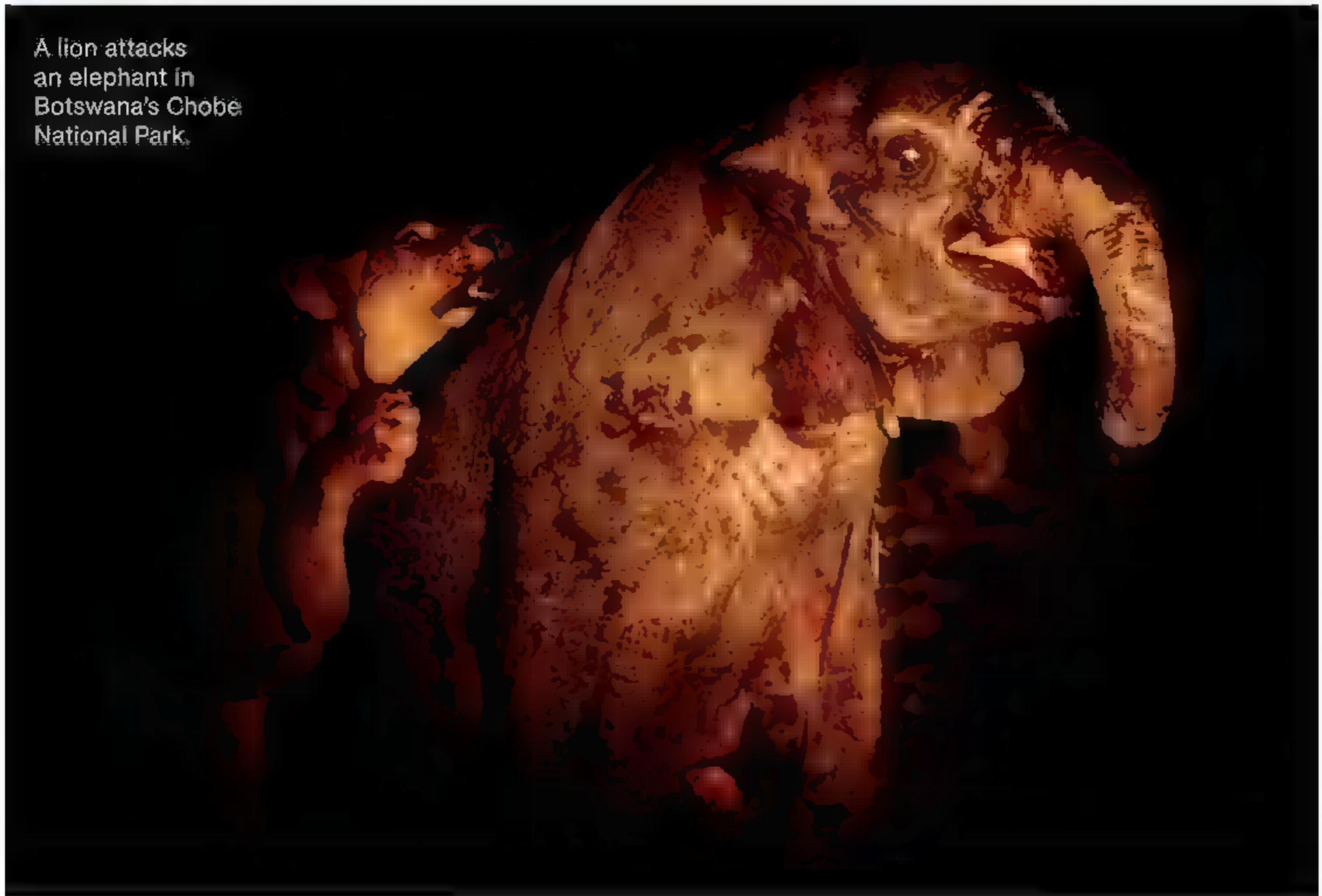
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A lion attacks
an elephant in
Botswana's Chobe
National Park.



unravels. If we can't protect this species, what hope is there for the rest?

The main problem for lions is human beings. Hunters in Africa shoot hundreds of wild lions each year (in fact, 517 trophies were legally exported to the U.S. in 2008, according to CITES). As villages move closer to national parks where lions live, buffer zones vanish and conflict increases. Poor farmers lack adequate education and resources for husbandry and protection of their livestock. The result is more conflict.

To address these problems, BCI helps educate African farmers about better livestock protection and has compensated them for cattle killed by lions. We've also funded a project in Kenya's Maasailand that builds "living walls"—fences

made with fast-growing indigenous trees that reach about 15 feet high. These walls help protect cattle from attack.

For three decades, we've made our home in remote areas of Botswana's Okavango Delta, a part of the world that is hidden to most people. Most of the time, it's just the two of us living in a tent, filming and researching cats, away from the complexities of what most people consider civilization. The rewards are great. We've captured amazing footage of lions attacking an elephant, and we've unlocked the mysteries of the intense relationships between lions and hyenas, and leopards and baboons. By getting to know individual animals intimately, we have helped to break down misconceptions about the world's greatest predators.

If you look into the eyes of a leopard, you can feel the deep, ancient connection between humans and this animal. We admire big cats; we fear them. We are at war with them in so many places on Earth. But there's one thing of which we're certain: Without them, we will be diminished.

Big Cats Initiative This Joubert-inspired project, supported by National Geographic, aims to assess, protect, and restore big-cat numbers. For more information go to causeanuproar.org.

Nat Geo WILD At 8 p.m. starting Monday, December 6, watch Nat Geo WILD's first annual *Big Cat Week*—seven nights devoted to nature's fiercest felines.

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Lynsey Addario (center, seated) and a group of Afghan women smile from a boat outside Kabul.

ON ASSIGNMENT Female Bonding Photographer Lynsey Addario has spent much of the past decade working in Afghanistan, often under dangerous conditions. But during her assignment for this month's feature, she and a group of young university women shared a feeling of freedom while taking a boat ride on the Qarghah Reservoir. In nice weather the area is typically filled with people, explains Addario, but this early morning, the women were almost alone save for their driver. "It was one of those rare moments when we all let our guards down," she recalls, "and were just a bunch of giggling girls."

NG BOOKS The President's Photographer John Bredar's companion to the National Geographic television special (airing November 24 on PBS—check local listings for time) of the same name, *The President's Photographer* invites us to learn the private stories of the official White House photographers. These men—nine since the first was appointed in 1962—have illustrated the pages of *Life*, *Time*, and *Newsweek*; the five still alive today share the memories behind their iconic images. Current White House photographer Pete Souza wrote the foreword to this book, which includes coverage of President Barack Obama. Revealing close-ups in moments of both joy and anguish, plus unexpected angles on historic events, *The President's Photographer* is available in bookstores now (\$35).

Society Updates

AWARDS

Cathy Newman, a *Geographic* staff writer and editor at large, has won the prestigious Italian *Premio Istituto Veneto per Venezia* for her "Vanishing Venice" story, which ran in our August 2009 issue.

COMPLETE NAT GEO

An updated version of *The Complete National Geographic* (in DVD-ROM or hard-drive format) can now be ordered at completenatgeo.com.

GeoPuzzle Answers

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If You Acquired a Gillette M3Power Razor between May 1, 2004 and October 31, 2005

You may Be Entitled to Benefits From a Class Action Settlement

There is a proposed settlement with The Gillette Company in a class action lawsuit, *In re M3Power Razor System Marketing & Sales Practices Litigation*.

What is the Class Action Lawsuit About?

The lawsuit challenges the accuracy of Gillette's advertisements for the M3Power Razor ("M3P"). Plaintiffs claim Gillette's advertisements that the M3P "raises or stimulates hair up and away from the skin" were false and misleading and violated consumer-related laws in the USA and Canada. In mid-2005, Gillette deleted those representations from its ads. Gillette denies all the allegations but has agreed to the proposed settlement to resolve this class action.

Who Is A Class Member?

Settlement Class Members include all persons in the USA or Canada who obtained an M3P in the USA between **May 1, 2004** and **September 30, 2005**, or in Canada between **May 1, 2004** and **October 31, 2005**. Persons who purchased the M3P for re-sale are **excluded** from the Class.

What Does The Proposed Settlement Provide?

Gillette has agreed to make \$7,500,000 available to a Settlement Fund. The fund will be used to provide Settlement Class Members who submit a valid, timely claim with **either** a refund (a minimum of \$13 US or \$16.25 Canadian, depending on the place of purchase) for their M3P, **or** up to two \$5 US rebates (up to a total of \$10 US, or the equivalent in Canadian dollars) for any M3Power blades and/or any Fusion or Fusion ProGlide razor purchased before **May 2, 2011**, **or** a new Gillette manual men's razor as a replacement, and other relief.

Claims are limited to one per person and three per household. If claims exceed the amount available for settlement benefits, claimants for replacement razors will not receive a benefit and the refunds and rebates will be reduced pro-rata. If claims do not exceed the amount available for settlement benefits, class members may receive additional benefits.

Who Represents Me?

The U.S. District Court for the District of Massachusetts has appointed Ben Barnow, Barnow and Associates, P.C. and Robert M. Rothman, Robbins Geller Rudman & Dowd LLP as Settlement Class Counsel. Subject to Court approval, Gillette will pay fees, costs, and expenses of Settlement Class Counsel, as well as incentive awards to the individual plaintiffs who brought the lawsuit. These amounts will not be deducted from the settlement fund. You may hire your own attorney, if you wish, at your own expense.

What Are My Legal Rights?

If you do not want to be legally bound by the proposed settlement, you must exclude yourself in writing, postmarked by **March 4, 2011**, and sent to the Settlement Administrator at the address below. If you stay in the Settlement Class, you may file a claim. Your claim must be postmarked by **May 2, 2011**. You may object to any aspect of the proposed settlement. Your written objection must be postmarked by **March 4, 2011**. You also may request in writing to appear at the Final Fairness Hearing. The Court will hold a Fairness Hearing on **March 25, 2011** at 2:00 p.m. to consider whether the proposed settlement is fair, reasonable, and adequate and the motion for attorneys' fees, costs, and expenses. If objections have been received, the Court will consider them at this time.

How Do I Obtain Further Information?

This is only a summary of the proposed settlement. For a more detailed Notice on the proposed settlement, a copy of the Settlement, and how to file a claim:

Call: 1-877-506-4030 (Se Habla Español) Visit: www.m3powersettlement.com

Write: M3Power Settlement, P.O. Box 2302, Faribault, MN 55021-9002



The Sound and the Furry “Too shrill for the human ear to hear,” a little bat’s voice turned visible when the animal was placed before a microphone hooked up to a cathode-ray oscilloscope. “The streaks above and below the central luminous spot are the visual representation of the creature’s cries, which have a frequency of 50,000 cycles per second—some 30,000 above the maximum range audible to man,” noted this photograph’s caption in “Mystery Mammals of the Twilight,” published in the July 1946 *Geographic*. “Such experiments... first proved that bats ‘see with their ears,’ guiding their flight by the echoes of their cries.” —Margaret G. Zackowitz

👉 **Flashback Archive** Find all the photos at ngm.com.

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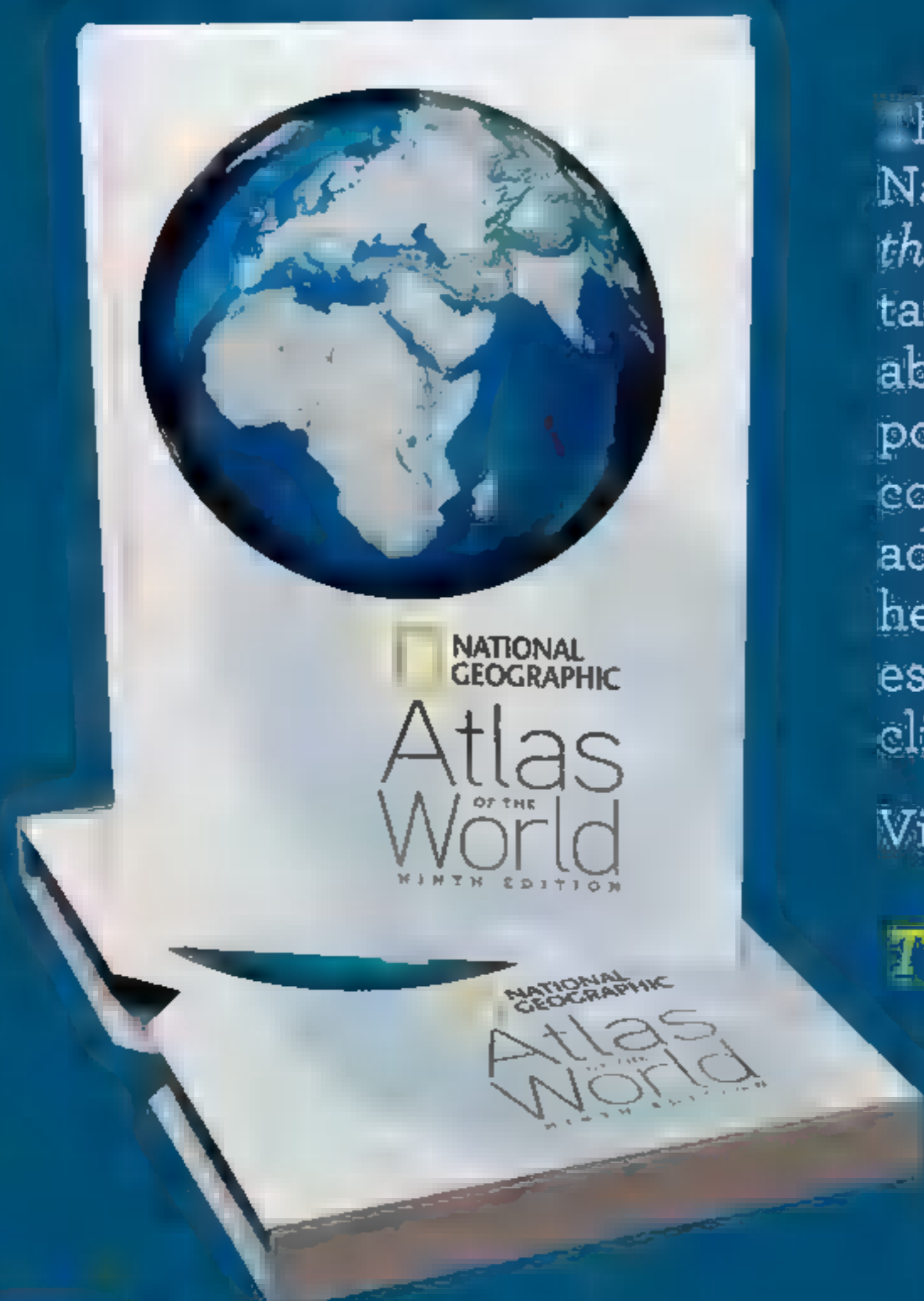
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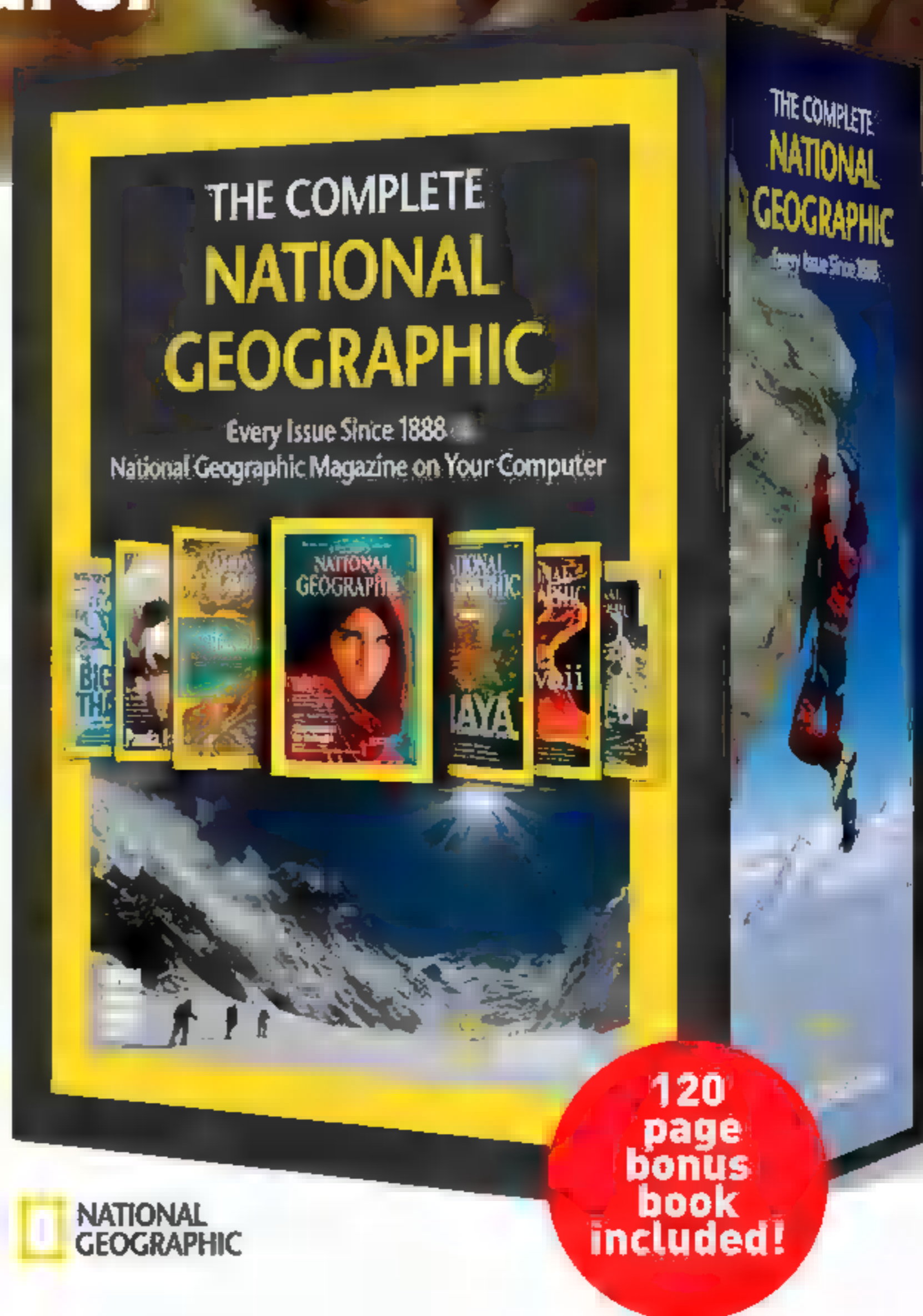
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Congratulations to the five visionaries who have been selected as the 2010 Rolex Awards for Enterprise Young Laureates: Jacob Colker (United States), Reese Fernandez (Philippines), Nnaemeka Ikegwonu (Nigeria), Piyush Tewari (India), and Bruktawit Tigabu (Ethiopia).

The Rolex Awards for Enterprise Young Laureates Programme fosters innovation in the next generation by supporting young men and women at a critical juncture in their careers; enabling them to implement groundbreaking ideas that tackle the world's most pressing issues in five areas: science and health, applied technology, exploration, the environment, and cultural preservation.

Please visit young.rolexawards.com to learn more.



ROLEX AWARDS for ENTERPRISE
YOUNG LAUREATES PROGRAMME

GEOPUZZLE



DOWN

- 1 Hilo hello
- 2 Subject of modern engineering
- 3 Hem again
- 4 Rap sheet letters
- 5 Engage in fighting
- 6 Samoa's capital
- 7 German Christmas carol "Stille _"
- 8 Historic period
- 9 The Cards, on scoreboards
- 10 _ School (painting genre depicting gritty city life)
- 11 Blacken
- 12 Major-__ (steward)
- 13 War action
- 18 Kind of ground archaeologists "dig"
- 22 Ga. neighbor
- 24 "Mind if __ myself out?"
- 26 It's "across the pond"
- 27 Like Sunday drivers
- 29 Cheapen
- 31 A Philippine surrender site of 1942
- 32 Fourth qtr. start
- 33 Wily tactic
- 34 Communications code word for a
- 35 Cash drawer
- 36 Take a __ (try to accomplish)
- 38 "It feels like zero!"
- 41 90 degrees
- 42 Zero
- 43 Oktoberfest quaff
- 48 Reacted to a strong punch
- 49 W. Hemisphere defense alliance
- 51 Panini bread, often
- 53 Baseball's Sandberg and Duren
- 55 Supplementary component
- 56 Kind of pollution
- 57 He was followed by a Ford
- 58 Wands waved at winds, e.g.
- 59 It may need dusting
- 60 Enmity
- 62 To be, at the Forum
- 65 Olé in America
- 66 __-Aztec languages
- 67 Deer's kin



Downsized

Puzzle by Cathy Allis

Myotis lucifugus is no bigger than your thumb. It is endangered by white-nose syndrome, a devastating and deadly fungus that strikes during hibernation (story, page 126). The species lives mainly in North America but can also be detected in this month's GeoPuzzle.

ACROSS

- 1 Taj Mahal's city
- 5 Hamlet and countrymen
- 10 Flexible, as electric adapters
- 14 Green onion-like vegetable
- 15 Eyeball-bending genre popular in the 1960s
- 16 Scat!
- 17 Taking a year off, perhaps
- 19 Soccer champ Mia
- 20 Laugh half
- 21 Bryce Canyon's state
- 22 Agile circus performer
- 23 Moving like an eddy
- 25 Physicist for whom a coil is named
- 28 Told a whopper
- 30 Capital of Mongolia
- 34 On an ocean voyage
- 37 Major river of Spain
- 39 Puncture prefix
- 40 What are threatened by a deadly nose-whitening fungus and are lurking in this puzzle's answers
- 44 Ga. neighbor
- 45 Advocacy org. for seniors
- 46 Golfer Palmer, to pals
- 47 Something bird-ensome?
- 50 It borders Peru and Col.
- 52 No faster?
- 54 Tennessee Williams title reptile
- 58 Cookie-baking quantities
- 61 "Uh-huh"
- 63 Dingo, for one
- 64 Vaccine type
- 65 Slugger's statistic
- 68 Short letter
- 69 Early nuke trial
- 70 Shrink one's spare tire
- 71 Tore
- 72 Book after Daniel
- 73 Had down

Answers in
Inside Geographic

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Domtar

Smarter business for a Smarter Planet:

What 27,383 computations per second mean to this energy meter.

They mean this meter will be read 24 times per day, instead of once per month. Giving consumers more visibility into their energy consumption and utility companies a deeper understanding of how energy is being used. eMeter worked with IBM and is using Power Systems™ and IBM application and service management software to enable utilities to manage data from over 20 million smart meters making readings every hour—or more than four times the scale of other utilities industry benchmarks¹. A smarter business is built on smarter software, systems and services.

Let's build a smarter planet. ibm.com/meter



A visualization of the data from eMeter's readings for an average home for one year.

¹ Based on published benchmark results. Results as of 9/13/10. Sources: IBM press release <http://www-03.ibm.com/press/us/en/pressrelease/29315.wss> and eMeter press release <http://www.emeter.com/2009/emeter-demonstrates-industry%E2%80%99s-most-scalable-smart-grid-management-capability/>. IBM, the IBM logo, ibm.com, Power Systems, Smarter Planet and the planet icon are trademarks of International Business Machines Corp. registered in many jurisdictions worldwide. Other product and service names might be trademarks of IBM or other companies. A current list of IBM trademarks is available on the Web at www.ibm.com/legal/copytrade.shtml. © International Business Machines Corporation 2010.